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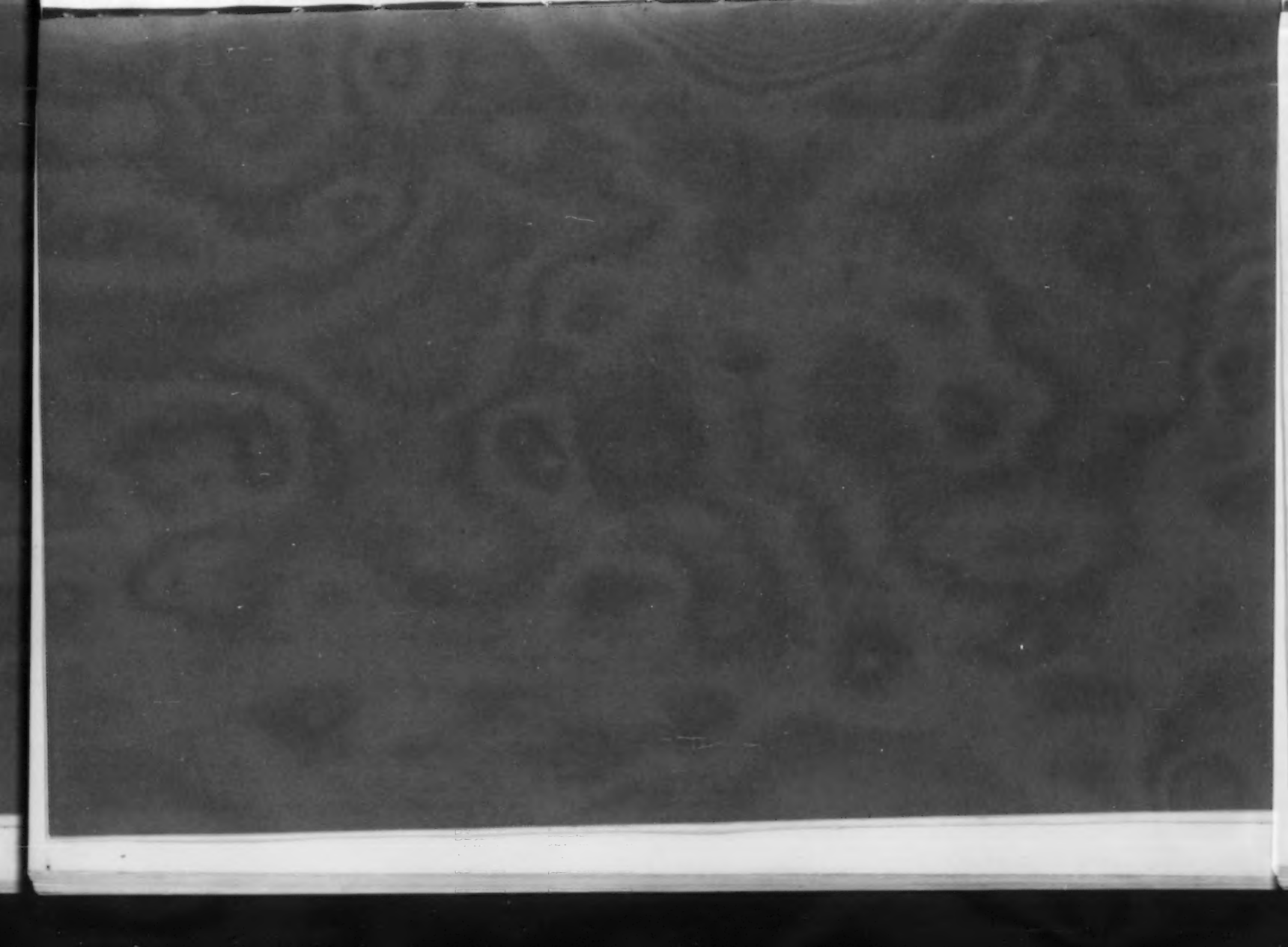

THE
GEOGRAPHICAL REVIEW

VOL. IX SEPTEMBER, 1920 NO. 9

THE PROBLEM OF SANTO DOMINGO

BY FRED ROGERS FAIRCHILD
Yale University

An interesting experiment in American statesmanship was inaugurated by the action of the United States when, in April, 1916, American marines landed at old San Geronimo castle, near Santo Domingo City, and the first step was taken in the American occupation of the Dominican Republic. Threatened civil war was thus averted, and, after some armed resistance had been overcome and political obstacles had been finally removed, a proclamation was issued on November 29, by Captain (now Rear Admiral) H. S. Knapp, commander of the American naval forces in Dominican waters, declaring the republic under the military administration of the United States.

The problems resulting from this action are many, and one seeks in vain for any clear statement to guide our policy in the administration of the affairs of a weaker nation, whose irresponsible political career has more than once forced her upon the attention of the United States. The attempt to secure the development of rich natural resources without exploitation, to protect ourselves against disorders without denying the right of our neighbors to self-government, is fraught with difficulties. Yet in the adequate solution of these problems must lie the justification for the presence of the military power of the United States in the Dominican Republic.

HISTORICAL SKETCH

In many ways Santo Domingo makes a strong appeal to our interest. Historically, her connection with the adventures of Columbus and the first white settlement in the Western hemisphere endows her with a glamour of romance, which has been deepened by her four hundred years of turbulent history. Her geographical situation on the great trade route between the

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Old World and the New, her economic resources, and the character of her people furnish the elements of a particularly significant study for the thoughtful American, in view of the recent developments in the relations between our Government and the smaller republic.

The doleful tale of Santo Domingo's long-continued attempt at self-government, with its bewildering succession of presidents and its lurid record of revolution and bloodshed, is matter of history.[1] Irresponsible finance and flagrant disregard of her international obligations finally brought the republic into conflict with certain European powers. Under the threat of invasion, the Dominican Government appealed to the United States for help. An arrangement was accordingly made, in 1905, under which the United States Government assumed the management of the Dominican public debt and the control of her customs administration. The debt was funded, the foreign creditors appeased, and the customs honestly and efficiently managed.

For some time things went fairly well, and considerable improvement in the country's economic condition followed. But the old habits were not to be so easily thrown off. Once more bandits arose and revolutions broke out in the good old way. A new national debt grew up, in violation of the agreement with the United States. This breach of faith and the increasing disorders finally led to the American occupation in 1916. Since then the Military Government has administered the legislative and executive departments of the national government. The judicial branch and the main control of local government have been left in the hands of the Dominicans.

In the winter of 1917–1918 the writer served as financial adviser to the Military Government, and it is upon observations made at that time, supplemented by later information from the Military Government, that this article is mainly based.

An Island of Vast and Varied Resources

The island of Santo Domingo, or Haiti, lies midway between Cuba and Porto Rico in the long chain of the West Indies. It is divided between the republics of Haiti and Santo Domingo, the latter occupying the eastern two-thirds of the island and having an area of about 18,000 square miles, about the combined area of New Hampshire and Vermont. It is five times the size of Porto Rico. Its greatest length is 260 miles and its greatest breadth 170. Its coast line, quite irregular and indented with large bays and good harbors, is more than 1,000 miles in length. Puerto Plata, the principal northern city, is some 1,250 miles from New York and 700 miles from Havana, Cuba.

A central mountain range, the Cordillera de Cibao, divides the country into two great regions. On the north is a wonderfully fertile valley, some

[1] See in particular Otto Schoenrich: Santo Domingo; A Country With a Future, The Macmillan Co., New York, 1918.

150 miles in length and from 10 to 15 miles wide, which, with the rich slopes to the north, is known as the Cibao. On the other side of the mountain range is the great southeastern plain, extending from the Jaina River west of Santo Domingo City to the eastern extremity of the island, 175 miles long and about 30 miles wide. This area, known as the Seibo Plain, also has fertile soil and favorable climate. A considerable area in the western part of the country is arid and unsuited to agriculture except with irrigation. The central portion of the republic is mountainous, containing some features that are distinctly imposing. Loma Tina rises to an altitude of over

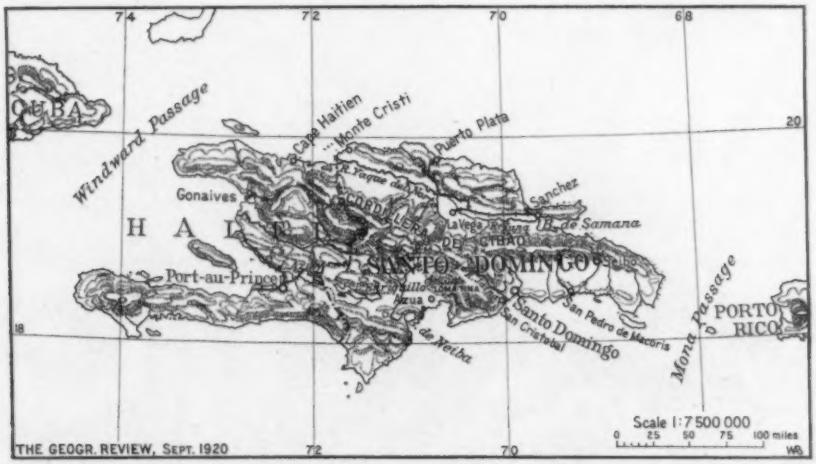

FIG. 1—Sketch map of Santo Domingo.

10,000 feet and is the highest peak in the West Indies. There are several large rivers, generally torrential and often losing much of their water through seepage into the soil before reaching the sea. The only lakes of any size are Lake Enriquillo and Lake Azuey in the western part near the Haitian border. Though scarcely five miles apart Enriquillo is 102 feet below, and Azuey 56 feet above, sea level. Both are salt lakes and are said to have no outlets.

Santo Domingo has a delightful climate, a soil of great fertility, and a remarkable abundance and variety of natural resources; yet four hundred years of white settlement have scarcely witnessed the beginning of material development. Economically she is still a primitive community.

LEADING PRODUCTS

The leading products of the country are agricultural, the most important being sugar, cacao, tobacco, coffee, skins and hides, bananas and some other fruits, honey and wax, cotton and other vegetable fibers, coconuts, etc. There is almost nothing in the way of general farming or truck gardening

beyond the small garden patch that supplies the family table. Many agricultural products that could apparently be raised in the country are imported. For example, rice is one of the chief articles of diet of the people and is practically all imported. Considerable areas are suited to grazing, but there has been little development along this line. The cattle are of inferior breed, and the native meat can scarcely be considered a delicacy. Milk and butter are almost unknown.

FIG. 2—The gate of San Diego, Santo Domingo City. This, called also the Gate of the Admiral, is one of the three original gates of the city. It is near the ruins of the house of Diego Columbus and affords communication, through the old city wall, from the wharves to the city.

The country is rich in timber of various kinds, including mahogany, lignum vitæ, and other valuable woods. A small amount is obtained for local use, and a little is exported. Near the chief seaports the supply of marketable timber is pretty well exhausted, while the enormous forest resources of the interior are virtually untouched. There is no extensive logging or lumbering industry at present, the chief obstacle being lack of transportation facilities.

Little is known of the nature or extent of the country's mineral resources. From time immemorial the natives have washed gold from the river sands, and these deposits appear to be widespread. There is some mining of copper. Oil has been found but not successfully marketed. Various other minerals are said to be abundant. It is possible that considerable mineral wealth awaits future discovery and development.

The waters surrounding the island abound in fish, but no important fisheries are developed.

With the single exception of the sugar mills, there is no very important manufacturing industry. A few distilleries and some small factories for the making of soap, cigars, cigarettes, candles, etc., are almost all there is beyond the stage of simple domestic handicrafts; and even here there is only slight development.

FIG. 3—Old houses and fortifications, Santo Domingo City. The city, founded by Bartholomew Columbus in 1496, is the oldest white settlement in the New World. (Photograph by the late Theodoor de Booy.)

THE SUGAR INDUSTRY

The one up-to-date enterprise is the sugar industry. The soil of Santo Domingo is remarkably suited to the growing of sugar cane, and the climate is favorable. So rich is the soil that cane will grow from the same roots for ten or even twenty years, whereas in Porto Rico replanting is generally necessary every three years. Sugar plantations have developed rapidly in recent years. Much foreign capital, principally American and Italian, is invested in the sugar estates and in the grinding mills, plantation railroads, irrigation systems, and other equipment. These establishments are great business enterprises, thoroughly up-to-date in plant and organization. Besides the cane raised on the estates a very considerable product is grown on small plantations by native *colonos*, who sell it under contract to the mills. The sugar estates and mills give employment to many Dominican

laborers; but the supply of native labor is not sufficient to harvest the crop, and the companies bring in laborers from the neighboring islands, returning them at the end of the season. The sugar is ground on the island or in the neighboring mills of Porto Rico, but there is no refining of sugar in Santo Domingo. San Pedro de Macoris, in the vicinity of which most of the large plantations are situated, is the chief sugar-exporting port.

Transportation

Means of transportation are in a very backward state. There are two railroads, with a combined length of barely 150 miles. They connect the two chief ports of the northern half of the island, Puerto Plata and Sanchez, with the rich interior. The sugar estates have their own private railway systems, mostly narrow gage. There are about 125 miles of such railways. Electric railways do not exist. A few years ago good roads were practically unknown. Since the American occupation some progress has been made in the construction of first-class roads, of which about 180 miles have been completed. Except for these few modern highways, the people depend on the most primitive country roads and trails. Transportation on land is generally by pack animals and rude carts, with a few motor-bus lines operating between cities connected by roads. Large parts of the country are practically inaccessible, especially in the rainy season.

Most of the important towns are on the seacoast, and transportation between them is by boat, with poor and irregular service. Needless to say, internal commerce is only slightly developed, though inadequate transportation is not the only cause.

Foreign Commerce

Foreign commerce, on the other hand, is of great importance. Since the Dominicans devote themselves so completely to agriculture and the simplest industries, they are compelled to rely upon foreign trade for almost everything they need in the way of manufactured goods. The figures of exports and imports make a very respectable showing for a country of the size and character of Santo Domingo, and the absolute dependence of the people upon imported goods makes the foreign trade even more important than the mere figures would indicate. The accompanying table (Table I) shows the value of imports and exports during recent years.

The table testifies to the large growth of the country's foreign trade since the Customs Receivership began compiling the statistics. It should be remembered, however, that a considerable part of this increase is only nominal, being the result of rising prices. It is evident that Santo Domingo has a large excess of exports—what is popularly called a "favorable balance of trade." Part of this balance represents payment of interest and amortization upon the national debt, practically all of which is held abroad. This calls for a heavy tribute averaging about $2,000,000 a year. Another factor

in the trade balance is the large investment of foreign capital in the country's industries, particularly the sugar estates. Interest and profits paid to foreign investors account for millions of dollars of exports. Like every debtor nation, Santo Domingo must thus pay with her products an annual charge to her foreign creditors. Only the excess above this charge gives her the power to command imports of foreign goods.

TABLE I—FOREIGN COMMERCE

	EXPORTS	IMPORTS
1905	$6,986,098	$2,736,828
1906	6,536,378	4,065,437
1907	7,628,356	4,948,961
1908	9,396,487	4,767,775
1909	8,113,690	4,425,913
1910	10,849,623	6,257,691
1911	10,995,546	6,949,662
1912	12,385,248	8,217,898
1913	10,469,947	9,272,278
1914	10,588,787	6,729,007
1915	15,209,061	9,118,514
1916	21,527,873	11,664,430
1917	22,444,580	17,581,814
1918	22,376,574	20,168,952

The principal articles of export are the products of the country's extractive industries already named. Table II shows the values of the most important articles exported in the year 1918.

TABLE II—VALUE OF CHIEF EXPORTS, 1918

Sugar (raw)	$11,991,399
Sugar cane	513,402
Molasses (of sugar)	142,356
Cacao	3,917,012
Tobacco leaf	3,623,780
Coffee	536,573
Honey	584,779
Beeswax	163,137
Goat skins and cattle hides	169,156

The imports into the country represent a great variety of necessities, most of them, though not all, being manufactured articles. The sixteen principal groups, with their values in 1918, as analyzed by the Customs Receivership, are given in Table III.

TABLE III—VALUE OF CHIEF IMPORTS, 1918

Cotton and manufactures of cotton	$3,643,806
Vegetable fibers, and manufactures of	1,088,426
Rice	2,543,320
Wheat flour	512,786
Foodstuffs (except rice and wheat flour)	1,375,458
Hides and skins, and manufactures of	782,562
Mineral oils	619,274
Woods, and manufactures of	475,710
Iron and steel, and manufactures of	1,501,531
Machinery and apparatus	1,888,292
Agricultural machinery, tools, and implements	238,045
Automobiles	199,265
Other cars, carriages and vehicles, and parts	427,832
Chemicals, drugs, oils, fats, etc.	352,468
Liquors and beverages	345,416
Cement	227,065

BUSINESS AND SOCIAL CONDITIONS

Business organization in Santo Domingo is generally very primitive. With a few notable exceptions there is no development of "big business." Few enterprises are incorporated. There are three banks. Two of them are branches of the International Banking Corporation of New York and of the Royal Bank of Canada respectively. They are important institutions and do a considerable business, mainly in the cities. The Banque Nacional is a local institution of less importance. The country districts are very poorly supplied with banking facilities. The sugar mills and estates are the largest and most highly organized enterprises. They belong to corporations of foreign investors. The single large banana plantation belongs to a foreign corporation. The rest of the country's agricultural industry is in the hands of individuals and small companies. Copper mining is being carried on in a small way by a corporation with foreign capital. There are no large interests engaged in cattle raising or logging. One of the railroads belongs to the Dominican Government; the other is the property of a corporation of English and Scotch capitalists. There are no other large corporations engaged in the transportation business except the steamship companies. Water transportation with the outside world is in the hands of foreign steamship companies; there are just two locally owned steamboats, each the property of a Dominican corporation. Communication by telephone, telegraph, and wireless is in the hands of the Government. The French Cable Company owns the submarine cable and a few land telegraph wires.

There is little accumulation of wealth among the people. A very few persons might be called moderately wealthy; only a small number could be classed as even well-to-do. The great mass of the population is distinctly

FIG. 4

FIG. 5

FIG. 4—Preparing an old sugar cane field for replanting. The soil of the Dominican cane lands is so rich that replanting is only necessary every ten years or more. (Photograph by the courtesy of Bartram Bros., New York.)

FIG. 5—Raising bulls for cane hauling. (Photograph by the courtesy of Bartram Bros., New York.)

FIG. 6

FIG. 7

FIG. 6—Cane transportation from the field to the railroad by bullock carts. (Photograph by the courtesy of Bartram Bros., New York.)

FIG. 7—Sugar cane in cars waiting to be milled or ground. (Photograph by the courtesy of Bartram Bros., New York.)

FIG. 8

FIG. 9

FIG. 8—Sugar factory of the American-owned Consuelo estate in the neighborhood of San Pedro de Macoris. This factory has an annual production of 35,000 tons of raw sugar. (Photograph by the courtesy of Bartram Bros., New York.)

FIG. 9—Raw sugar in the warehouse awaiting shipment. (Photograph by the courtesy of Bartram Bros., New York.)

poor, with only the bare necessities for life on a low standard of living. However, the climate and the bounty of nature make it an easy matter to maintain this standard.

The educational system is very primitive. There are no important private educational institutions, the church does almost nothing in this field, and the little that is done by the Government is wholly inadequate.

Although the Roman Catholic religion is recognized in the constitution as the national religion, church and state are practically separate. The people are mostly Catholic, but the influence of the church is declining, particularly among the men. There are no large holdings of land or other wealth in the hands of the church or of religious orders.

Political Organization

Politically Santo Domingo is a republic, at least in name, with the ordinary legislative, executive, and judicial branches. The chief executive is the President. His cabinet comprises the secretaries who head the seven departments. The national congress consists of a senate and a chamber of deputies. The country is divided into twelve provinces, which are subdivided into 65 communes. The provincial governments are of little importance. Their functions are primarily military, and they have little to do with the civil government. Their governors are appointed by the President. Before the American occupation they were usually local chiefs or bandits who, through their control of the military system, were largely independent of and often in revolt against the national government. The communes are the seats of local government, though they have less autonomy than the towns and counties of the United States. Their organization and functions are prescribed by the national constitution and laws, and the national government exercises a good deal of control over local affairs.

The People

The Dominicans are an interesting people—a mixed race of Spanish and negro blood with a strain of the Indian. They are kindly, courteous, and friendly, with many admirable qualities. Their wants are few, and their lives are simple. Contrary to the popular impression created by their unsavory record of revolution and disorder, they are generally of a most peaceful disposition. But among them is a sufficient number of the lawless and violent to keep the country in turmoil. These are the bandits, whose operations have continued to some extent even under the American occupation. They are the material which furnished the "generals" and "presidents" in the former days of independence. This small class is probably the only element of the population which is not satisfied with American rule. But until this generation has passed away, restoration of independence would almost certainly bring a recrudescence of the old disorders.

National Finance

To the student of public finance the Dominican Republic offers a field of unusual interest. In no other aspect of their national life did the Dominicans exhibit to such a degree their failure in self-government. In fact it is no exaggeration to say that finance was the rock upon which their ship of state was wrecked. Their tax system, resting almost exclusively upon customs and excise duties, bore no slightest mark of an attempt to distribute justly the costs of government. Public expenditures were made in the interests of the group of "patriots" for the time being in control of the government and wholly without regard to the development of the nation or the welfare of its people. It was the revenues of the customhouse that furnished the bone of contention for revolutionists and rival presidents. It was disregard of the obligations of its national debt that brought the country into conflict with the governments of its European creditors in 1904 and led to the agreements of 1905 and 1907 under which the United States took charge of the customs administration and the national debt. And finally, failure to live up to the financial terms of this agreement and collapse of the internal revenue system were the chief causes of the intervention of the United States in 1916.

The national revenues in the year 1916 amounted to $4,709,518. Of this total, $4,035,355, or 86 per cent, came from customs taxes, including duties on exports as well as imports. The customs, being since 1905 in the hands of the American Customs Receivership, presented the unique spectacle of an honest and efficient administration, with correspondingly large returns. Other parts of the revenue system were in the hands of the Dominicans. Excise taxes, of a bewildering variety, produced $401,757, less than 9 per cent of the total revenues. License and business taxes yielded the small sum of $201,178, and all other sources together produced the remaining $71,228.

The most significant feature of this revenue system is the complete reliance upon indirect taxes. We look in vain for anything in the way of a property tax or an income tax. No attempt had apparently ever been made to adjust the burdens of taxation to the ability of the people to pay. The indirect taxes were mainly on necessities of life, as such taxes must always be if they are to yield a large revenue. Such taxes are notoriously a burden upon the poor, their pressure growing constantly lighter as we ascend the scale of economic well-being. It was perfectly evident that their taxes added much to the cost of living and put many important articles practically out of the reach of the mass of the people. Such taxes are also a check upon business and an obstacle to the economic development of the country. On account of the efficient administration of the heavy customs duties, and in spite of the lax management of the rest of the tax system, the total of the national revenues was actually a large amount in consideration of the circumstances of the country. An annual revenue of $5,000,000 was contributed by a

population of probably not over 500,000 or 700,000. That meant a per capita tax of seven to ten dollars—a heavy burden in view of the poverty of the people and the country's backward economic development.

The finances of the provinces are of little importance. They have no independent sources of revenue and receive no contributions from the communes. Their wants, consisting of a few salaries and office expenses, are met directly out of the national budget.

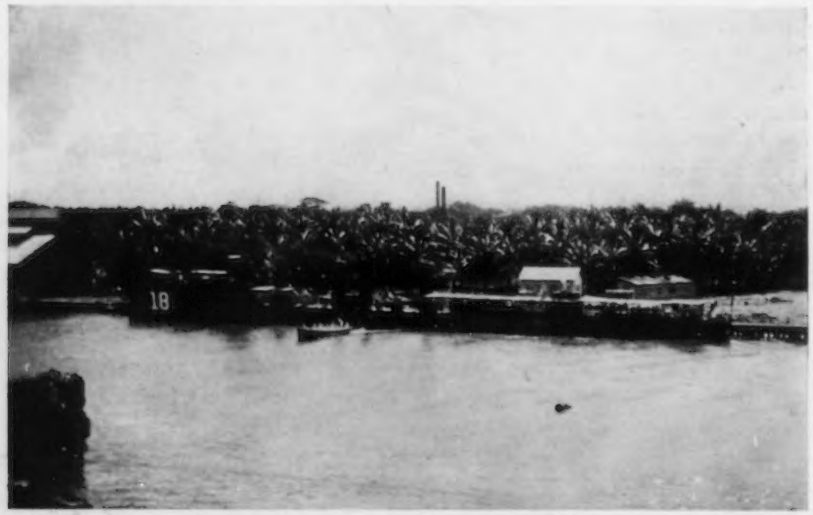

FIG. 10—Eastern bank of the Ozama River, Santo Domingo City. (Photograph by the late Theodoor de Booy.)

MUNICIPAL FINANCE

The communes of Santo Domingo enjoy the most extraordinary revenue system that the present writer has ever met. There are no official reports of communal finance. Through the kindness of the National Controller General the writer secured reports from nearly all the communes covering the revenues of 1916 and the budget estimates of 1917. From these reports it was possible to identify some 33 different kinds of revenue, besides an unknown collection masked under the title of "miscellaneous." The total revenues in 1916 were $750,000. Nearly half came from licenses and business taxes. Almost half the balance was from customs and octroi duties. There was almost nothing in the way of direct taxes. Among the monstrosities in this bewildering collection, we note a communal customs tariff on goods imported into the country, which is entirely independent of the national customs. Each commune imposes its own rates, which of course tend to destroy the character of the national tariff system and add greatly to its burdens. There are a communal export tax on sugar and a system of communal port dues. The license and business taxes stretch their deadly

tentacles over a great number of occupations and are a heavy burden on industry. In the whole local system it would be hard to find a single example of sound taxation.

Effects of American Occupation

In the three years of American occupation, the Military Government has gone far in justifying its presence, even in the eyes of the Dominicans themselves. With some occasional lapses law and order have been maintained

Fig. 11—Native boats on the Ozama River at Santo Domingo City. (These boats are dugouts: they bring charcoal and country produce to the city market.)

throughout the greater part of the country. The cities and adjacent country districts are as safe as any American community. The control of the national government, particularly the finances, has removed the chief inducement to revolutionary uprisings. Apparently the great majority of the Dominicans are well pleased with the results and would be the first to protest against a return to independence and lawlessness.

The Military Government is taking an active and intelligent interest in every phase of national development. Agriculture is being promoted by experiment stations, agricultural education, and the dissemination of information among the people. In every branch of industry the Government is seeking to aid the people to develop intelligently the national resources. The discouraging problem of public education has been vigorously attacked. Finally the two directions in which the Military Government shows the most important results are public works and finance.

Mention has been made of the poverty of transportation facilities. The problem of good roads was one of the first to which the Military Govern-

ment set itself. Practically all the progress that has been made in modern road building is due to its efforts, and it is rapidly pushing forward the execution of a broad plan for a national system of highways. Nothing could possibly be of greater immediate service to the nation. The Military Government has also taken hold of the Dominican Railroad and is putting it into shape for efficient service. Improvements in harbors, construction of docks and customhouses, and installation of machinery for loading and unloading ships are other examples of an intelligent policy of public works. The cost of these improvements is being met out of the Dominican revenues, which have shown a healthy growth under American occupation.

Reform of the Financial System

As finance was the Dominicans' worst stumbling block, so finance offers the Military Government its greatest opportunity for service. Even before the American occupation the national debt had been put on a sound foundation, and the customs faithfully administered, through the good offices of the United States. Under the control of the Customs Receivership, customs revenues increased from $2,500,000 in 1905–1906 to $5,333,000 in 1917, though the war's interference with foreign commerce caused a decline of about $1,000,000 in 1918. The occupation of 1916 gave the Military Government an opportunity to show what could be done by equally honest and efficient administration of the internal revenue system. The revenue from this source was $674,000 in 1916. Next year it nearly doubled ($1,234,000), and in 1918 it was $1,701,000. The total gross revenues in 1918 were over $6,000,000. Besides administrative improvements the Military Government has changed the customs and internal revenue laws so as to render them more equitable and less burdensome on the country's trade and industry.

The most important change in the fiscal system was the introduction of a national property tax (promulgated April 19, 1919). The law places a tax upon land and permanent improvements, including industrial machinery, railroad and mining equipment, and ships, and a tax upon titles to undivided lands. Lands are taxed at progressive rates from one-half of one per cent to two per cent, according to area. The rate on improvements is one-fourth of one per cent. Titles are taxed five cents on each *peso* or other unit. On the subject of land titles something will be said later.

The reform most needed in the Dominican tax system was the substitution of direct taxation for much of the prevailing mass of indirect taxes and licenses. The property tax was the logical remedy. The income tax would have no opportunity among a people of such general poverty. Practically the entire wealth of the country is in the form of land and natural resources connected with the land. This wealth the new tax seeks to reach. The writer cannot approve of the progressive rate of the land tax, and the discrimination in favor of improvements smacks a bit too much of the single

tax. But, on the whole, the measure is a wise one. It marks a long step forward on the road to sound taxation and industrial progress.

The Problem of Land Titles

Of all the problems before the Military Government the most difficult is that which has to do with the extraordinary condition of land titles in the Dominican Republic. This is a subject which has never received adequate study. Its maze of historical ramifications and legal technicalities is both fascinating and bewildering. It is not possible here to present more than a brief general summary of the historical development and present status of land titles.

Land titles in Santo Domingo are in a state of chaos. It is safe to say that in the whole country there is not a single perfect title, as we understand the matter. The original grants were made in the distant past and are shrouded in mystery. There has never been a system of recording titles that deserves the name. At different times the country has been under the rule of Spain, France, Haiti, and numerous Dominican "republics." Each has done its best to undo the work of its predecessors and destroy their records. When to this situation is added an almost "continuous performance" of revolutions and bandit forays, one can readily understand the fate that has befallen most of the records, kept in the palm huts of the village notaries. Records of original grants as well as of later transfers have generally been lost or destroyed.

But this is not the worst of it. The most serious difficulties arise from the peculiar system of common lands (*terrenos comuneros*), which are tracts owned in common by a number of persons without division among the owners. These communal lands appear to have had their origin in the period of the Spanish Government. The crown granted to various persons large tracts, whose boundaries were described more or less indefinitely by reference to geographical features, such as the sea, a river, a range of mountains, etc.; the geographical names employed were those in common use among the natives at the time. When the owner of a grant died, it was not customary to divide the land among his heirs. Instead a notary public was employed to set a money value upon the whole tract and to give to each heir a title of a certain money value representing his share of the whole. These shares, expressed in *pesos*, are known as "*acciones*" or "*peso* titles." The device may be understood by comparing it with the ordinary joint stock corporation, in which each share represents the stockholders' undivided interest in the rights of the whole corporation.

When the owner of *peso* titles died his share would be distributed among his heirs without any division of the land, and so on for generation after generation. *Peso* titles were sold from time to time, without specifying any particular part of the original tract as passing to the purchaser. Loss and destruction of records of these transactions made a bad matter worse.

There was also wholesale fraud, opportunity for which is obvious. An owner frequently sold to different purchasers titles whose aggregate was many times his entire share. Counterfeit titles have been manufactured, often with the aid of dishonest notaries, and sold in large quantities to trusting purchasers.

The result of centuries of this sort of thing is a chaos of land titles which beggars description. No land survey has ever been made. Most of the land is in these undivided tracts. The country is flooded with *peso* titles, some genuine, some counterfeit, and none free from suspicion. The *peso* values stated in the titles bear no relation whatever to the value of the land; and it is often impossible, from the wording of any particular *peso* title, to locate exactly the land to which it refers.

Occupation of land and ownership of land titles have little connection with each other. Many owners of *peso* titles have never occupied the lands to which their titles refer. Others have occupied and cultivated parts of their tract with scant regard to the rights of the other *peso* owners. Still other "squatters" are in possession of lands to which they have no title whatever. Land is so abundant that this sort of informal possession has grown up easily. It is almost impossible to decide as between the present rights of squatters and of title holders. The Dominican laws on the subject are not clear, particularly with reference to *terrenos comuneros*.

Occasional efforts have been made to clear up the tangle of land titles. Back in the middle of the eighteenth century, disputes between co-owners and between owners and squatters led to the appointment of a judge to examine titles and protect the legitimate owners. But little was accomplished; and the new titles, *amparos reales*, issued to certain owners, only served to add to the confusion. Recently the Dominican Congress, in 1912 and 1915, has taken a hand and passed certain laws. This legislation was ambiguous, has not been enforced, and has accomplished nothing.

The whole problem is thus handed on to the Military Government. It has shown some natural hesitation to tackle the gigantic task. But the obligation could not be avoided. If for no other reason, the new property tax will never function satisfactorily with land titles in their present state. The Government now has a commission investigating the whole subject, and at last the problem appears to be on the road to settlement. Nothing that could be done would go farther to promote sound finance, to encourage investment of capital and business development, and to justify the presence of the military power of the United States.

FORESTS AND HUMAN PROGRESS

By Raphael Zon

U. S. Forest Service

Forests have had an important effect on the distribution of mankind over the earth's surface. They have deeply affected the spiritual and religious life of the tribes living within them or near by. They have been a source of raw material indispensable to the economic development of the human race. The relations between forests and man are manifold and varied throughout the course of human progress from the primitive stage to the present highly developed economic organization.

There may be recognized three stages in the relation of man to forests:

(1) Civilization dominated by forests.
(2) Civilization overcoming the forests.
(3) Civilization dominating forests.

Just as we had the stone age, the bronze age, and the iron age at the same time in different parts of the earth, so we have simultaneously the three stages of the relation of man to the forest. Thus in central Africa and South America man in his relation to the surrounding forest is in the first stage; in a considerable part of North America and in Asia he is in the second; and in Europe and in parts of the United States he is already in the third.

Civilization Dominated by Forests

If no attempt is made to go back into the mode of life of our simian ancestors, whose abode must have been the forest,[1] and our survey is confined to the beginnings of civilization in Europe, Asia, and America, one fact stands out clearly; namely, that the forests in the early stages of human progress did not offer favorable conditions for the settlement of primitive man; on the contrary, they were always an element inimical to the spread of mankind over the earth.[2]

The first and most striking evidence that this is so is the fact that only few traces of prehistoric man are found in densely forested regions. The chief memorials of Neolithic man in Britain, for instance, are found on the moorlands which in these ancient times appeared as islands of open habitable land above the vast stretches of swamp and forests.[3] A study of the occur-

[1] Attention, however, may be called to Barrell's thesis that desiccation and reduction of the forest (central Asia) acted upon our simian ancestors as a controlling factor in the evolution towards man (Joseph Barrell: Probable Relations of Climatic Change to the Origin of the Tertiary Ape-Man, *Scientific Monthly*, Vol. 4, 1917, pp. 16–26).

[2] Robert Gradmann: Das mitteleuropäische Landschaftsbild nach seiner geschichtlichen Entwicklung, *Geogr. Zeitschr.*, Leipzig, Vol. 7, 1901, pp. 361–377; reference on p. 366.

Karl Sapper: Die mittelamerikanische Landschaft, *Geogr. Zeitschr.*, Vol. 8, 1902, pp. 489–515; reference on p. 492.

[3] H. J. Fleure, Racial History of the British People, *Geogr. Rev.*, Vol. 5, 1918, pp. 216–231; map on p. 219.

rence of human settlement from the earliest Stone Age tells the same story; namely, that the cradle of human civilization was not a primeval forest.

The first great nuclei of population, the seats of the earliest recorded civilizations both in the Old and in the New World, originated in arid regions, at best only scantily covered with forest.[4] In the Old World the Egyptian, Babylonian, Assyrian, and Phoenician civilizations arose in hot and dry regions in climate not unlike southern Arizona and New Mexico. Within the "rainless belt" extending across North Africa, Arabia, Persia, and on through Tibet into Mongolia, or from the borders of it, have come all the conquering races of the Old World.

Similarly in the New World the nations which developed a high degree of civilization were those in the arid regions of Mexico and Peru—the Aztecs and the Incas.[5]

Primeval Forests an Obstacle to Human Migration and Colonization

Forests have acted as barriers to human colonization in all parts of the world. In the Alleghanies as well as in tropical West Africa[6] the forest for many decades delayed the penetration of the white man into the interior of the continent. It took the American colonists about 200 years to reach the crest of the Appalachians.[7] It prevented the spread of the Hamites[8] from North Africa southward and stopped the movement into the Congo region of the cattle-keeping aristocracies such as the Bahima which had a social, political, and military organization superior to other tribes. In the heart of the Congo forest no traces of an ancient population have been found. All evidence points to the comparatively recent penetration of man.[9] The expansion of the Inca Empire from the high plateaus of Peru and Bolivia eastward was limited by the impenetrable forests of the headwaters of the Amazon River.[10] Attempts to penetrate down the eastern valleys brought feeble results. In contrast is the southward expansion of the Empire—to or beyond the river Maule—by roads where neither the frigid heights of the Cordillera nor the inhospitable desert proved so formid-

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[4] Paul Vidal de la Blache: La répartition des hommes sur le globe, *Ann. de Géogr.*, Vol. 26, 1917, pp. 81–93 and 241–254; *idem:* Les grandes agglomérations humaines: (1) Afrique et Asie, *ibid.*, pp. 401–422 (abstracted in the *Geogr. Rev.*, Vol. 7, 1919, pp. 52–53).

[5] Remains of the Maya civilization are now found in the dense tropical forest. Huntington however suggests that this civilization arose and flourished during a time of drier climate. The succeeding moister period favored the growth of that type of heavy forest so inimical to human progress. Ellsworth Huntington: The Climatic Factor as Illustrated in Arid America, *Carnegie Instn. Publ. No. 192*, Washington, D. C., 1914.

[6] Siegfried Passarge: Die natürlichen Landschaften Afrikas, *Petermanns Mitt.*, Vol. 54, 1908, pp. 182–188, reference on p. 186.

[7] M. K. Genthe: Die geographischen Grundlagen der amerikanischen Geschichte, *Geogr. Zeitschr.*, Vol. 15, 1909, pp. 386–408; reference on p. 390.

[8] Emmanuel de Martonne: La vie des peuples du haut Nil, *Ann. de Géogr.*, Vol. 5, 1895–96, pp. 506–521; Vol. 6, 1897, pp. 61–70; reference on p. 63.

[9] Sir H. H. Johnston: A Survey of the Ethnography of Africa, *Journ. Royal Anthropol. Inst.*, Vol. 43, 1913, pp. 375–421; reference on p. 396.

[10] Alfred Hettner: Regenverteilung, Pflanzendecke und Besiedlung der tropischen Anden, in "Festschrift Ferdinand Freiherrn von Richthofen." Berlin, 1893, pp. 197–233; reference on p. 229.

able as the barrier of the forest. The history of the Spanish conquest is similar: the forest continued to mark the boundary of effective control. Indeed much the same is true today.

The Ancient European Forests

The Romans, the greatest colonizers of olden times, were forced to stop in their expansion and Empire building at the boundaries of the dense, virgin German forests whose inhospitable and somber nature was pictured in dark colors by such ancient writers as Tacitus,[11] Pomponius Mella,[12] and Marcellinus,[13] who spoke of the forests as of something horrid and inaccessible and unsuited for human habitation. The more recent European historians, such as Gradmann[14] for instance, consider the boundary of the Roman Empire as coinciding with the western boundary of the coniferous forests of southern Germany. The strategic genius of the old Romans clearly perceived that it was not the German mountains themselves, which were only moderate in height, that formed the bulwark of the ancient Teutonic freedom but the vast primeval forests with which they were clothed. In their writings they referred to the *saltus* (break or forest) and not to the Montes Germaniæ.

Just as the Romans were compelled to stop in their colonizing activities at the boundary of the virgin forests of central Europe, so the successive later waves of the nomadic tribes which moved from the eastern prairies westward—Huns, Magyars, Avars, and the like—broke up when they reached the barrier of primeval forests. The routes of migration in western and central Europe were largely determined by the openings in the primeval forests.[15]

The difficulty with which primeval forests could be penetrated made them always an obstacle to all great historic migrations of man. On the grasslands pack animals could be used, and here the wheeled cart originated. In the primeval forest where a path must be hacked out with the aid of ax and knife man must be his own burden bearer.[16] Three or four miles a day is the average rate of travel in such forests. Not infrequently man depends here on the animal trails. Mammoth and rhinoceros in the ages past were the first trail builders in the forests of central Europe, just as the elephants are breaking trails now in the African and eastern Asiatic forests to be later followed by man. The bear trails served as roads for the Teutons in the primeval forests of Europe, just as they are now doing in the forests of

[11] Silvis horrida, paludinibus foeda (*Germania*, 5).

[12] Terra montibus aspera, silvis ac paludinibus invia (*De Chorographia*, 3, 3).

[13] Horrore silvarum squalentium inaccessum (*Rerum Gestarum Liber*, 15, 4).

[14] Robert Gradmann: Der obergermanisch-rätische Limes und das fränkische Nadelholzgebiet, *Petermanns Mitt.*, Vol. 45, 1899, pp. 57–66.

[15] Paul Vidal de la Blache: La France—Tableau géographique, Paris, 1908, p. 29 and accompanying map.

[16] Georg Dressler: Fusspfad und Weg geographisch betrachtet, *Mitt. des Vereins für Erdkunde zu Leipzig* Vol. 45, 1905, pp. 137–239; reference on pp. 176–181.

Kamchatka and Siberia for the hunters of fur animals.[17] In North America, a Humboldt remarks, the "bison pointed out to man the best roads through the Cumberland Mountains." In medieval Europe the wild cattle broke the first trails in the forest, just as in our own western forests the cattle trails were the first which many of us traveled.

Forests of the North

In the northern forests the main obstacles to the movement of man are vast swamps and muskegs. In winter the snow cover usually improves the facilities for movement. Light sleds, skis, and snowshoes are then the chief means of travel.[18] In summer, however, this advantage of the northern forest over the tropical one is lost, and it is necessary to use the rivers for roads. Where these rivers are often interrupted by rapids or falls, light transportable canoes had to be used, as they are still being used by the North American Indians. Such means of transportation, although they are of great help, are not, of course, sufficient or adequate for easy communication. For this reason all world trade routes have always kept away from virgin forest regions. Not a single transcontinental railroad has yet been cut through the forest region of the Amazon or Congo, and such railroads as the Trans-Siberian and the Canadian Pacific skirt only the southern boundaries of the virgin boreal forests.

Middendorff [19] in his travel through eastern Siberia was surprised at the scarcity of wild game, which became abundant only toward the steppes and in the vicinity of human habitation. In his travel through the forests he found an insurmountable obstacle in the vast swamps. In winter when they are frozen over it is possible for men to enter the forest and cut wood, but it is out of the question to establish a permanent dwelling on the unstable ground. The swamp forests, therefore, are not inhabited. Even where the soil is not swampy the foot sinks deep in decaying vegetation, while fallen, dead, or diseased trees lie athwart the dense upright trunks and thus impede movement. Darwin, in his ascent of Mt. Tarn in Tierra del Fuego, encountered difficulties of a similar character.

The records left by ancient writers regarding the primeval forests of central Europe agree with descriptions given by modern travelers of the forests of the north which still remain intact. Pliny presents a picture of the primeval forests of central Europe which is not unlike that given by Middendorff of the primeval forests of eastern and western Siberia. He speaks of gigantic trunks capable of holding up thirty men in the water, of oak roots lifted like arches or forming mounds of earth, and of great islands of wood floating on the rivers; just as the rivers of Siberia today

[17] A. T. von Middendorff: Reise in den äussersten Norden und Osten Sibiriens, 4 vols. and atlas, St. Petersburg, 1848–75; reference in Vol. 4.

[18] H. Baulig: Sur la distribution des moyens de transport et de circulation chez les indigènes de l'Amérique du Nord, *Ann. de Géogr.*, Vol. 17, 1908, pp. 433–456.

[19] Middendorff, *op. cit.*

are cumbered with trunks of trees uprooted and accumulated in huge natural rafts, so that to travel even by water is difficult.

Dense, extensive forests are perhaps the most formidable of natural barriers. Areas which otherwise would be easy of access, become unfriendly and inaccessible when covered with high and dense forest vegetation. Mountain slopes which if cleared would be accessible are inaccessible when covered with a dense forest. As Arrigo Lorenzi has pointed out, even the low and twisted forest vegetation characteristic of the dolomite region of the eastern Alps—and that of the San Bernardino Mountains of southern California might also be instanced—presents a serious obstacle to travel.[20]

The Sparse Population of the Forest

Comparison of a map showing the density of population or settlement with one showing the distribution of the principal natural types of vegetation, such as desert, forest, grassland, shows at a glance that the most scattering population is found in the deserts and in the large stretches of primeval forest. This holds true of the northern forests of the temperate region and the tropical forests of the Amazon and of northern Australia, where the density of population is less than one per square mile, as well as of the Congo forest and the primeval forests of southeastern Asia, where the density of population is also very low. This belt of sparse population is clearly distinguished from adjoining prairie or otherwise treeless regions, where the density is considerably greater. Similar maps, only on a larger scale, for individual countries show that the timbered belt in the mountains has a thin population while the valleys below are densely populated.[21] Even the alpine meadows above the timber line may have a denser though temporary population. In the timbered belt are found only a few huts of hunters and wood-choppers.

A primeval forest at the lower stages of human civilization is of little importance as a source of trade. The local demand for wood material is fully supplied from the fringes of the forest region. The export of large quantities of wood is out of the question because demand and means of transportation are lacking. There remains only hunting and grazing. It is true that throughout the Middle Ages hunting and pasturing of swine in the forest were not insignificant sources of revenue to many a king. This, however, was also possible only on the outskirts since the interior of the dense and dark primeval forests is unfavorable even for wild animals. Every one who has traveled through the virgin Douglas fir forest of Puget Sound has been impressed by the lack of animal and bird life. An occasional squirrel or chipmunk is about all that one is likely to see for days. The

[20] Arrigo Lorenzi: L'uomo e le foreste, *Riv. Geogr. Italiana*, Florence, Vol. 25, 1918, pp. 141–165, 213–242; Vol. 26, 1919, pp. 47–57. Special mention should be made of this suggestive study to which the writer is indebted for several of the instances used in this paper.

[21] For an admirable illustration from the Austrian Alps see the maps of population (Pl. 11) and use of the land (Pl. 10) in Norbert Krebs: Länderkunde der österreichischen Alpen, Stuttgart, 1913.

primeval forests of Asiatic Russia, the so-called Siberian *taiga*, and the tropical *selvas* of South America support very few wild animals. This is less true of temperate broad-leaved forests where abundant mast of beech and oak furnish food for animals and often for men. Such poverty and inaccessibility of the virgin tropical and northern coniferous forests make them almost entirely unsuited to human settlement. In the early colonial history of America the virgin forest was in the true sense of the word "No Man's Land."

Forests as Territorial Boundaries

The difficulty of traveling in the forests made them play, at the lower stages of human culture, the part of territorial boundaries. A wide forest belt served the purpose of defense against attack from a neighboring tribe or nation better than does the boundary line of the modern state.[22] This explains the existence of many forests as political boundaries in the ancient nations of central Europe. Classical examples of the function of the forests as political boundaries are afforded by the forests of the mountain ranges of central Germany, which, according to the description by Julius Caesar, extended for a distance of 9 days' travel in width and 60 in length and first separated the settlements of the Celts from those of the Teutons[23] and later became the boundary between northern and southern Germany. The outside boundaries of the ancient Teuton Empire were the forest-covered mountains of the Ardennes and Vosges,[24] which from the Carolingian time until the twelfth century served as the most effective defense against attacks from the west; and the Bohemian, Silesian, and Pomeranian forests provided a similar protection on the east.[25] In the same way, what is now Austria and once was a part of the ancient German Empire, was separated from Hungary and protected from attacks by the Hungarian hordes, not by the narrow Leitha River, but by the wide belt of mountain forests and the forest-covered valleys that lay between the mountain chains.[26] Primeval forests which extended as far as the Danube had served also as political boundaries separating the old German province of Austria from Bohemia.[27] According to Grimm, the German word *Mark*, which means boundary, was originally a synonym for *Waldland*, or woodland.[28] The old Romans also considered forest and boundary as synonymous terms, and the God Sylvanus was the protector of both. Many other examples of the same kind can be mentioned.

[22] Julius Lippert: Social-Geschichte Böhmens in vorhussitisches Zeit, 2 vols., Vienna, 1896–98; reference in Vol. 1, p. 24.

[23] Heinrich Kiepert: Lehrbuch der alten Geographie, Berlin, 1878; reference on p. 535.

[24] Vidal de la Blache: La France, p. 177. See also pp. 30–31 on the rôle of the forest in the establishment of ancient boundaries. And see Albert Demangeon: La Picardie, Paris, 1905, pp. 425–435.

[25] H. F. Helmolt: Die Entwickelung der Grenzlinie aus dem Grenzsaume im alten Deutschland, *Historisches Jahrbuch. Im Auftrage der Görres-Gesell.*, Munich, Vol. 17, 1896, pp. 235–264.

[26] Robert Sieger: Die Grenzen Nieder-Österreichs, *Jahrbuch für Landeskunde von Niederösterreich*, Vol. 1, 1920, pp. 183 and 207.

[27] Alfred Hackel: Die Besiedlungsverhältnisse des oberösterreichischen Mühlviertels, *Forschungen zur Deutschen Landes und Volkskunde*, Stuttgart, Vol. 14, 1903, pp. 1–77; reference on p. 37.

[28] Heinrich Nissen: Italische Landeskunde, 2 vols., Berlin, 1883 and 1902; reference in Vol. 1, p. 43.

Thus the forests served as political boundaries between the Franconian, Swabian, and Hessian possessions, between Gaelic and Breton holdings. The forest district of the "Weald" separated the Anglo-Saxon territories of Kent and Sussex.[29] The Norwegians consider the sparsely inhabited forest belt which lies south of latitude 62° N. between their own and Swedish territories as the "most natural political boundary."[30]

If in Europe at present there remain only traces of the historic significance of forests as state and political boundaries, in other parts of the world, especially among the more primitive races, this function of the forests stands out very clearly. Thus in central Africa, according to many explorers, the areas which serve as boundaries between the native tribes are always void of human settlements because, for the most part, they are forest-covered. The most striking demonstration of this is found in the 160-day journey of Stanley in the forest region of the Congo and also in the travels of Junker over the divide between the Nile and the Congo. Junker records an interesting observation, namely, that the tribes are wilder and less cultured in proportion to the width of the forest belts which act as boundaries separating one tribe from another. Thus the Niam-Niam region in Africa in the north is separated from that of the Nile negroes by a thick forest belt 25 miles broad. In the Kassai region of the Congo, Wolf found a state surrounded on all sides by a wide belt of primeval forest. On the Islands of Oceania there are village communities which are hidden almost entirely from the traveler by dense mangrove forests.[31]

Forests as Boundaries in North America

The forests have also played the part of territorial boundaries for many Indian tribes of North America. Before the advent of the white man on this continent each nation, or tribe, occupied a definite territory separated from the territories of the other Indian nations.[32] It was only after the white man came to the continent and after some of the Indian tribes, like the Sioux in the plains, had secured horses that the Indian nations, under the pressure of the white man, acquired nomadic habits. Practically all of the North American Indians had their settlements outside of the forest, either along lakes and rivers or on high plateaus free of timber, in the woodland and lowland type, or in the plains.

Although the aboriginal settlements were not established in the forests and the forests acted as barriers to migration, they were too necessary to the Indian—furnishing him with food, clothing, canoes, etc.—to be wholly avoided. There is no doubt, however, that he regarded the forest with fear

[29] Vidal de la Blache: La France, p. 31.

[30] Hans Reusch: Norwegens Verhältnis zu Schweden vom geographischen Gesichtspunkte aus, *Geogr. Zeitschr.*, Vol. 11, 1905, pp. 425–435.

[31] Richard Mahler: Siedelungsgebiet und Siedelungslage in Ozeanien, Suppl. to *Internatl. Archiv. für Ethnogr.*, Leiden, Vol. 11, 1898.

[32] J. W. Powell: Indian Linguistic Families of America North of Mexico, *7th Ann. Rept. Bur. of Ethnol.*, 1885–86, pp. 1–142.

and superstition. The Indian greatly feared the spirits of the dead, and since many of the Indian tribes placed their dead in canoes in the forks of trees or on high poles, it was only natural for them to believe the forests to be haunted. In traveling to and fro, the Indian avoided the deeper forests, following streams as much as possible, though when necessary he crossed the forest in search of food or to make war. The hunting lots or territories of many of the Indian tribes were more or less fixed tracts of country, whose boundaries were determined by natural landmarks, mostly by forests. In an article in *Harper's Magazine* for 1869 Edward T. Coleman, in describing his ascent of Mt. Baker, relates a story which may be indicative of the part which the forest played as the boundary line between the different Indian tribes:

> The Indians soon came back to camp in great wrath, occasioned by the discovery of a piece of wood cut by an ax. This trace of man in such a desolate and uninhabitable country deeply interested me but had a violent effect on my savage companions. They explained that the Thompson River Indians had evidently been poaching on their hunting grounds.

The Yakima Indians living on the eastern slope of the Cascades and the Puget Sound Indians were divided by a forest belt of about 50 miles in width, which they thought was haunted by "stick" Indians. The wide forest belt acted as a barrier between the two, although there were some trails over the low passes.[33]

It is interesting to note in the diary of Lewis and Clark in their trip across the continent that the only time they did not meet Indian tribes was when for nine days they crossed the lodgepole pine forests of Montana.

The Forest as Refuge of Man

The mere fact that there are races and tribes which live exclusively within the primeval forests shows, of course, that although the forest on the whole is inhospitable to human settlement it is not entirely prohibitive. The very reasons for which man in most cases avoids the forests as a place for permanent settlement may attract some people, who, for one reason or another, at their own will or otherwise, shun the densely populated communities which are found largely in the open valleys. Some religious fanatics go into the woods in order to withdraw themselves from the sinful world. Criminals hide in its remote interior in order to escape the strong arm of the law. Brigandage in Corsica has been encouraged by the dense *maquis* with which at least half the island is covered and which afforded the brigands a safe shelter from any punishment by law. The activities of Robin Hood in Sherwood Forest, which still linger in our memory from boyhood days, illustrate the point. The moonshiners of Tennessee and Kentucky afford an example nearer home.

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[33] George Gibbs: Tribes of Western Washington and Northwestern Oregon, *Contributions to North American Ethnology*, Washington, 1877, Vol. 1, pp. 157–241.

The primeval forests extend their dark and safe covering not only to outlaws of human society, but also to large groups of people who may seek new life under conditions which they could not obtain in the older communities. The Quakers in North America and several religious sects of Russia have found in the forests their freedom of religion, and the Wends [34] in the forests of the River Spree have retained up to the present their Slavonic language which they did not wish to give up.

Primitive forms of worship protected by the forests long withstood the advance of Christianity, and even at the time of Petrarch "the ancient Prussians, in honor of their gods, burned the Knights of the Order that fell into their hands." Near Treves, according to Turonese, the worship of Diana in the depths of the forest lasted into the fifth century. Under the protection of their pine forests and wooded swamps the barbarian Lithuanians and Finns preserved not only their racial integrity but also their archaic language. In Flanders the Houtland (country of forests) up to an advanced period of history was occupied by forest tribes of a Lappish type who grazed their flocks in the natural openings of the forest. The so-called *bosschkerle* (bushmen) are the present representatives of these races.

When forests did not afford a safe defense in themselves then the natives resorted to the construction of additional barriers, which, primitive as they may seem to us at present, probably proved very effective for those times. Thus, for instance, many tribes would fell large quantities of timber, producing conditions similar to windfalls and in this way hamper the movement of warring neighbors. Such artificial defenses constructed in the forest and with the aid of timber were used for instance among the ancient Etruscans, Celts, Teutons,[35] and even in the Middle Ages among the Slavs in Bohemia and Silesia; and according to Stanley's[36] testimony even now such artificially constructed barriers are found among the natives of the Congo region, and they are reported from Borneo.[37]

In Caesar's Commentaries many references are found to the important part played by the forests in the resistance of the Gauls. The struggle against the Atrebates, the Nervii, and the Viromandui gives Caesar occasion to describe the singular "hedges" made of branches of trees and thorny plants with which the Nervii opposed the advancing cavalry. The *plexicium* of later days was a sort of live hedge similar to that of the Nervii. Both defensive arrangements were intended to supplement and reinforce the natural living rampart. It was only because of the forests that the Transalpine Iapydes resisted successfully and for a long time the invasion of the

[34] Albrecht Penck: Das Deutsche Reich, Vienna and Leipzig, 1887, p. 521. (Unser Wissen von der Erde, Vol. 2, Part I, Länderkunde des Erdteils Europa.)

[35] Friedrich Ratzel: Politische Geographie, 2d edit., Munich and Berlin, 1903; reference on p. 549.

[36] Sir H. M. Stanley: In Darkest Africa, 2 vols., London, 1890; reference in Vol. 1, pp. 78, 79.
Muller: Die Staatenbildungen des oberen Uelle-und Zwischenseengebietes, Leipzig, 1897, p. 66.

[37] Friedrich Ratzel: Der Ursprung und die Wanderungen der Völker geographisch betrachtet, *Berichte über die Verhandlungen der Königlich Sächsischen Gesell. der Wiss. zu Leipzig, Phil.-Hist. Klasse*, Vol. 50, 1898, pp. 1–75 and Vol. 52, 1900, pp. 23–147; reference in Vol. 52, p. 28.

Romans. Appian describes the way in which they made use of felled trees to hinder the advance of the Romans. In northern Italy also the Cisalpine Gauls struggled bitterly against the Romans, taking advantage of the forests. The praetorian Manlius, according to Livy, was surprised at two points where the road passed through wooded territory, and only with great difficulty and after severe losses did he succeed in getting through to the open country and joining Tanetus. Livy also tells how during the second Punic War the Boii cut the trees of the vast forest of Litana at the right and left of the road they were traveling, in such a way, that while the trees remained upright the slightest push would cause them to fall. This trap inflicted great losses on the Roman army.[38]

Primitive and Weak Tribes Relegated to the Forest

Alsatian legends record savage peoples relegated by civilization to the forests, where they finally disappeared. Similarly, in the local legends about the Silvani (forest dwellers) or Pagani (pagans) traces may be found of savage races who, hiding in the forests and on the high mountains, resisted the civilization which penetrated to the valleys of Carnic Alps.[39] The same also happens constantly among primitive tribes. Some small tribe threatened or conquered by a stronger one escapes from the danger of the stronger tribe or the yoke of the conquerors by moving away to the inaccessible jungles of the forest. The forests have thus given rise to the formation of small communities made up of refugees, wanderers, and small tribes which have split off from the larger tribes. It is into the dark primeval forest that one must go if one wants to study the Akkas and Batwas of Africa, the Veddas of India, the Kubus of Sumatra,[40] the Alfuros of the Celebes, the Negritos in the Philippines, the Ainus on Yezo, and the Botokudos of South America. It is only natural to expect that forest tribes made up of refugees would present a most variable ethnological conglomeration. The linguistic map of the Congo Basin speaks eloquently of the tribal divisions in this region.[41]

Uniform Characteristics and Habits of Forest Tribes

In spite of the ethnological differences of such forest tribes and of their distribution in different parts of the world, far removed one from another, they display common traits throughout. Forest tribes have developed a very characteristic way of building their dwellings. Thus, for instance, the peoples of the Melanesian islands and of New Guinea, and also some tribes of the forests of the Congo region build wooden shelters for 10 or 12

[38] Lorenzi, *op. cit.*

[39] *Ibid.*

[40] Wilhelm Volz: Die Religionslosigkeit der Kubus, *Petermanns Mitt.*, Vol. 57, 1911, p. 289.

[41] Sir H. H. Johnston: George Grenfell and the Congo, 2 vols., London, 1908. See the ethnographical map of central Africa.

persons, high above the ground, usually at an elevation of 80 to 100 feet. They construct high platforms upon which the dwellings themselves are placed.[42]

Forest tribes display similar mental characteristics. For instance, all forest aborigines are characterized by an extremely timid, even cowardly, appearance which does not betray in the least their cunning and perfidy. As soon as a traveler turns his back they are ready to send after him a poisoned arrow or spear. The forest makes possible the ambush, the predatory attack, the sortie, and the passive defense. It favors rapid retreat and scattering in small groups, which can then fight from ambush separately or unite for a new attack. Cruelty nearly always accompanies primitive sylvan life.

Economic and Political Life of Forest Tribes

The economic life of such forest tribes likewise presents a uniform simplicity consisting as it does of hunting, fishing, and the collecting of fruits from trees.[43] The gains from such occupation are meager and never certain. In consequence, on the one hand such peoples are physically underdeveloped, and on the other hand cannibalism is most common among them. It is possible that the pygmy races of the primeval tropical forests really became dwarfed as the result of deterioration under the difficult conditions of life in the environment to which they had been driven by a stronger tribe or race. Theodore Roosevelt, in his book on Africa, gives a vivid picture of such a pygmy forest tribe.

The almost entire absence of intercommunication with their neighbors and the consequent narrowness of their intellectual and spiritual horizon is also characteristic of forest tribes. Stanley, for instance, found in equatorial Africa a number of tribes living in the forest that had never heard or known about neighboring settlements, although the latter were only a few miles away from them. Stuhlmann [44] describes graphically the contrasts between conditions in the open country of German East Africa and in the forest where each tiny village is a world to itself.

Political organization among scattered forest settlements is always feeble. Hunting as the chief source of livelihood, with the necessity of wandering about in pursuit of animals, tends to disorganize any large unit. The very scarcity of game alone may hinder any attempt at political organization. The *tribe* is the more usual form of grouping because it represents an intermediate stage between dependence and independence. Even among forest populations at a higher stage of civilization when agriculture in the open places provides a more permanent means of livelihood, political organizations are weakly developed. The tribes of all Gaul

[42] Mahler: Work cited in footnote 31; L. Höesl: Über die Lage der Ansiedelungen in Afrika, *Das Ausland*, 1893, pp. 119–121; reference on p. 120.

[43] Ernst Friedrich: Geographie des Welthandels und Weltverkehrs, Jena, 1911, p. 37.

[44] Franz Stuhlmann: Mit Emin Pascha ins Herz von Afrika, Berlin, 1894, p. 423.

separated by vast forest stretches were very slow in uniting against the Romans. The Offensive and Defensive League of the Iroquois Indians, who occupied the territory south of Lake Ontario in the seventeenth century, although greatly feared by their neighbors and a continual menace to the French in Canada, lacked adequate organization.

Availability of Fuel from the Forest as a Limiting Factor in the Distribution of Man

As a source of fuel the forest has exerted a most powerful influence upon human progress. This influence has been the greater in proportion to the rigor of the climate. A very striking illustration of how the lack of forest-produced fuel has limited the spread of human habitation is contained in the fact that the polar boundary of human settlements in the interior of northern Asia closely coincides with the northern limit of forest vegetation.[45] Although the inhabitants of northern Asia in their nomadic migrations penetrate from time to time into the tundra, as a rule they never go very far from the northern edge of the forest because the forest is the only place where they can find a supply of fuel. Likewise the northern boundary of the settlements of the Indian tribes in America coincides with the polar boundary of the forest.[46] This is strikingly shown in the occurrence of the settlements in Alaska and Labrador. In Alaska the northern timber limit reaches as far as latitude 67° N.; in Labrador it ends at 52° N., or 15 degrees farther southward. The Indian settlements follow closely these fluctuations of the northern timber line. The historic significance of this difference in the northern limit of the forest comes out even more strikingly in comparing the Old and the New Worlds. In the Old World the northern limit of the forest, as well as that of human settlements, extends to latitude 70° N. In eastern North America it stops at 52°. In the New World, with the lowering of the northern forest limit, the historic arena has been pushed southward for from 8 to 10 degrees of latitude.[47] On the contrary, in Alaska, where the northern limit of the forest extends to latitude 67° N. there is a possibility of the development of a mighty community not unlike Sweden or Scotland.

Eskimo Life

Although Indian huts seldom occur beyond the northern limit of the forest, Eskimo settlements are found in the polar archipelago of America. But the settlements there cling to the seashore, for the reason that the sea furnishes them not only with food but also with fuel in the form of timber washed ashore. This explains why some of the islands are more thickly

[45] Kurt Hassert: Die Nordpolargrenze der bewohnten und bewohnbaren Erde, Leipzig, 1881, p. 50.

[46] Baulig: Work cited in footnote 18.

[47] Friedrich Ratzel: Die Anwendung des Begriffs "Oekumene" auf geographische Probleme der Gegenwart, *Berichte über die Verhandlungen der Königlich Sächsischen Gesell. der Wiss. zu Leipzig, Phil.-Hist. Klasse*, Vol. 40, 1888, pp. 137–180; reference on p. 175.

settled than others, as, for instance, the stirking difference in the settlements of Banks Land and the Parry Archipelago. The farther north we ascend along the western shore of Greenland the less driftwood is brought by the sea, and finally, south of the Kennedy Canal, the last driftwood disappears, and with it disappear the last settlements of the most northern Eskimos. The need for wood determines in part certain Eskimo migrations. Thus in the spring Victoria Islanders travel to the mainland and into the interior as far as Great Bear Lake where they obtain material for tent poles and bows.[48] Thus the influence of the forest upon man makes itself felt even many hundred miles away from the nearest forest stand.

The upper timber belt in the mountains has the same significance in limiting the settlements in mountainous regions. Thus in the Alps the highest altitude at which human settlements are still found is close to timber line and never extends beyond 450 or 500 feet above the timber. The Tyrol and the Adamello Alps between Italy and Tyrol are good illustrations of this.[49]

The Forest as a Molder of Spiritual and Religious Life

The forest left a deep impress upon the soul of primitive man. The mysterious twilight of the forest, its gentle rustling, and its weird moaning in storm endowed it with supernatural attributes.[50] The forest figures largely in the religious beliefs of primitive races all over the world. Sometimes trees are regarded as animate, as among the Hidatsa Indians who paid special respect to the shade of the cottonwood, the greatest tree of their territory in the Upper Missouri.[51] By many primitive peoples trees are considered to be the abode of the souls of the dead. According to the Ibo of the Niger delta not only have trees and plants souls of their own but certain trees are supposed to have been selected as the residences of human spirits, and such are held in great reverence.[52] Mention has already been made of the custom of tree burial among certain tribes of North American Indians. Australian tribes also buried their dead in the tops of trees believing that the spirits of the dead wandered therein and also the spirits of the unborn. The latter belief is similarly reflected in the custom known in parts of India where women who wanted to have children arranged religious dances under certain forest trees since these were the home of the children. The Hindu philosopher, Tagore, in his book on "The Realization of Life," describes very vividly the part which the Indian forests have played in the development of Indian civilization and philosophy.

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[48] Vilhjalmur Stefansson: My Life With the Eskimo. New York, 1913, p. 273.

[49] Hermann Reishauer: Höhengrenzen der Vegetation in den Stubaier Alpen und in der Adamello-Gruppe. *Wissenschaftliche Veröffentlichungen des Vereins für Erdkunde zu Leipzig*, Vol. 6, 1904, pp. 1–210. Compare the limit of habitations, pp. 58, 136 with the tree limit, pp. 93, 167.

[50] Oscar Peschel: Völkerkunde, Leipzig, 1877, p. 261.

[51] J. G. Frazer: The Golden Bough. The Magic Art, Vol. 2, pp. 7–58.

[52] A. G. Leonard: The Lower Niger and its Tribes, London, 1906, p. 298.

The influence of the forest upon the spiritual life of man is not confined, however, to primitive tribes. Our ancestors of ancient Europe similarly engaged in tree worship, and relics of it still survive in many ancient customs and superstitions—those attaching to the May tree and the Maypole for example.[53]

The Forest in Folklore, Poetry, and Art

Folklore, being the most spontaneous creation of the common people, is the best measure of the subtle influence of the forest. The folklore of North American Indian, Teuton, and Slav is permeated with the atmosphere and the joy of the forest. The folk songs are the finest and most vigorous in the regions where the forest has been best preserved. The cycle of stories which center around the lumberjack Paul Bunyon, recently collected by P. S. Lovejoy of the University of Michigan, breathe the atmosphere of the once extensive forests of our country and claim a place in our native American folklore. The words of the old "Crusaders' Hymn," of the year 1200,

> Schön sind die Felder,
> Schöner noch die Wälder

show the feeling of the German people. Many of the heroes of the German sagas, as Siegfried and Parsifal, begin their life in the forest and end it there.

Poetry and drama, although farther removed from the spontaneous reaction of the great majority of the people, still are indicative of the environment which influences the writer. Thus the wonderful forest scenes in *A Midsummer Night's Dream*, *As You Like It*, *The Merry Wives of Windsor*, and other Shakespearean plays could only be written by a man who was an enthusiastic lover of the woods and had lived under the influence of their beauty. Goethe's writings are full of appreciation of the beauty of the forest. We can pick at random such verses as these:

> Schon stand im Nebelkleid die Eiche
> Ein aufgeturmter Riese da.
> Wo Finsterniss aus dem Gesträuche
> Mit hundert Schwarzen Augen sah.[54]

Chateaubriand called the forests *temples primitifs*. He thus speaks of the forest:

> La forêt est sacrée, et ses hautes ramures,
> Où, selon les saisons, le vent prend mille voix,
> Ont éveillé le rêve à leurs vagues murmures
> Et mis l' homme à genoux pour le première fois.[55]

Landscape painting has drawn much inspiration from the forest. First of all, the oaks, beeches, elms, and maples with their delicately arched

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[53] Frazer, *op. cit.*, pp. 59–96.

[54] "The oak stood in a garment of mist, a mountainous giant, where darkness peered out of the bushes with a hundred black eyes."

[55] "The forest is holy, and its lofty boughs, on which the winds play a thousand notes, with changing season, by their gentle murmur awaken dreams and bring man to bended knee."

crowns, then the somber hemlock and spruce, the chaste birch, and the weeping willow—these provided many artists with material for their creations. The majestic forest awesome in its silent, mournful solitude, especially in winter, boisterous in storm, or terrible in the grip of a forest fire will live forever in the paintings of some of the Russian artists of the realistic school.

The forest is a great natural structure from which architecture has often borrowed its form. The trunks of the trees gave rise to the pillars of stone, the bending branches served as models for arches, and foliage and flowers provided the ornaments adorning many works of man.

Music has also found inspiration in the dense forest. Enough to mention Mendelssohn-Bartholdy's famous song,

Wer hat dich, du schöner Wald.

Civilization Overcoming the Forest

So much for the influence of the forest upon man. This influence was greatest when mankind was at comparatively low stages of civilization. At a certain stage there begins a reverse influence, namely, that of man upon forests.

Primitive man, possessing crude stone implements only, found but few parts of the earth's surface which were neither too barren nor too heavily forested to be suitable for his habitation. It is true that in recent times societies have to the greatest extent developed, both in size and complexity, in temperate forested regions. This, however, is not inconsistent with the fact that the first large human societies arose, and the primary stages of social development were reached, in arid and treeless climates. The earlier phases of progress had to be passed through where the resistances offered by natural conditions were least; only when the arts of life had been advanced did it become possible for societies to develop in regions where the resistance was greater; and it was only further development in the arts of life, with the further discipline in co-operation accompanying them, that enabled subsequent societies to take root and grow in regions where climatic and other conditions offered relatively great difficulties. At first man is the slave of his environment and only later becomes to a certain extent its master.[56]

First Steps in Destruction of the Forest

The primitive nations could not change to any marked degree the forest cover of the earth. Their tools were too crude, and, moreover, their activity was rarely concentrated at the same place for any length of time because their mode of life was largely nomadic. The primitive agricultural system,

[56] Buckle brings out this fact strikingly in explaining why a highly civilized nation could have developed in Peru, while in a country situated close to Peru in the same continent and lying in the same latitude (Brazil) there could be found no trace even of the most imperfect civilization. (H. T. Buckle: History of Civilization in England, 2 vols., New York, 1864; reference in Vol. 1, pp. 74–75.)

caingin making, of the Philippines could never have brought about the destruction of the forests, since the cultivators' efforts were never centered long enough at one place.[57] For this reason the effective influence of man upon the forest in the early days was confined to localities where it existed under very adverse conditions of climate or soil, as for instance on sand dunes, on the edge of the prairie or desert, or at its upper or northern limit. The Batusi and other peoples have encroached on the northeastern edge of the great central African forest. Today Ruanda is practically deforested. The remnants of the ancient forests that remain on the hill tops are regarded as sacred by the natives.[58] In Europe we find that man early succeeded in crowding out the forest in the Mediterranean region, where at best it had a hard struggle to maintain itself. This operation can be traced back even to classical antiquity.

The dense forests of central Europe did not give way before the efforts of the Romans or the ancient Teutons. Only in the Middle Ages, beginning with the era of Charlemagne, when there arose an imperative need for more room, did the Teutons succeed in clearing any large areas of the dense forests. This clearing was not the work of individuals but was the result of many concentrated and persistent efforts on the part of the religious and knightly orders.

Extent and Character of the Process of Clearing

Some idea of the extent and character of this process may be gleaned from a study of the geographic names of different settlements. There are in Germany alone not less than 6,905 names of places which indicate their origin in forest regions. An analysis of such names reveals also the part which different nationalities have taken in the colonization of forest regions and shows whether settlement took place on open land or on cleared forest land. In Bohemia, for instance, just as in the northern German lowlands, all areas poorly stocked with timber from time immemorial were occupied first by Slavonic nations, which had come to these lands long before the arrival there of the Teutons. The latter, therefore, were forced, as late-comers, to provide for themselves places of habitation amid the dense primeval forest by cutting it off, burning, and clearing the land for fields. In the same way the Romans in colonizing the Alps occupied the open places and left untouched the forested regions of southeastern Austria, which for a long time waited for colonists to come there from Franconia and Thuringia to turn them into fields and orchards. The same story has been repeated in the last century in southern Brazil. The creoles

[57] It is estimated that caingin making has destroyed over half the original forest cover in the Philippines. The abandoned areas quickly become covered with cogon grass and if kept free from fire forest ultimately comes back. J. Paul Goode: The Forests of the Philippines, *Bull. Amer. Geogr. Soc.*, Vol. 44, 1912, pp. 81–89.

[58] The Duke of Mecklenburg: In the Heart of Africa, London, 1910; reference on p. 51. On the deforestation of this portion of Africa see also C. H. Stigand: The Lost Forests of Africa, *Geogr. Journ.*, Vol. 45, 1915, pp. 513–520.

and negroes took possession largely of the prairie sections, leaving the forests to the nomadic South American Indians. The present settlement of the forest regions began only after the arrival there of European colonists who, not finding any more open land, began to clear the forest for settlement; and now some of the originally forested land is more densely populated than the open prairie.

Along the Atlantic shore of Central America the forests began to be cleared for human settlement only after the arrival there of negroes; and on the Island of Formosa clearing took place only through colonization by the Chinese, who, after having cleared the western part of the island, took possession of the entire island and crowded the original population to the eastern part of it.

The earliest settlements in the forest were comparatively small. In Germany the extensive clearings are of a later date than the barbarian invasions, and only the areas which were by nature more or less clear of forest were inhabited in antiquity. Likewise in independent Gaul, especially north of the Loire, cleared and inhabited lands were like small islands encircled by vast forests. A striking example of the island-like character of clearings in the forest may be seen today to the south and southeast of Munich.[59] Such small settlements, when made by a people of comparatively high civilization carrying on agriculture according to improved methods, may last a long time if the extent of the forest territory is very great in comparison with the population. Cultivation on a large scale involving the clearing and agricultural development of enormous areas of land was made possible only in modern times when man became armed with powerful machinery for removing trees and stumps.

The Forest as a Supplementary Source of Food

In the earlier settlements the surrounding forests served as a supplementary source of food for the primitive agriculturist. The cultivation of small parcels of cleared land was supplemented by grazing of stock in the oak or other adjoining forest. The forest also furnished acorns as food for animals and even men, while the wild animals provided meat and hides. During the period of such early agricultural settlements the forest was often protected from destruction because of its value as a hunting ground and as a source of food. There are many evidences of the economic importance of wild edible fruits in the forest in the early settlements of primitive man. In the prehistoric settlements the remains of beech mast have sometimes been found in heaps. Poets and writers of antiquity have preserved the record of the epoch in which the inhabitants of the country surrounding the Mediterranean were fed on acorns and other fruits of the forest. Aside from the Arcadians, called by other Greeks "the acorn eaters,"

[59] See Karte des Deutschen Reiches, 1:100,000, sheet 638 (Munich). Reproduced by Jean Brunhes: La géographie humaine, Paris, 1912, p. 97.

and the statements of Pliny about bread made of acorns, there are many historic evidences of the importance of the acorn in the early economic life of Europe and at a later period. Even today the acorns of various species of oak are an article of food in all the Mediterranean countries. Cultivation of land within the forest, coupled with the gathering of wild fruits, is still going on in many parts of the world, as for instance among the peasants of Siberia and the Indians of North America.

As the gathering of wild plants is displaced gradually in the course of economic evolution by the regular production of cultivated crops, stock raising supersedes the hunting of game. As an intermediate stage from hunting to stock raising there is often domestication of animals, as for instance, the breeding of foxes, in a state of semi-domestication, in certain islands of the Bering Sea and in Newfoundland; or the raising of bees in the forest of the Ural Mountains, which is a step in advance of the gathering of wild honey as carried on, for example, by the Veddas but is not rational apiculture with food supplied by properly selected and cultivated crops.[60] In the primitive horticulture of the primeval forest it is customary to cut down the trees in the portion of the forest destined for cultivation, then to burn all the wood or at least the branches and underbrush. The ashes serve as fertilizer; the ground is broken, and the seed, shoots, or tubers are planted. To remove the roots of the trees would be too difficult a task for primitive implements, hence the fields are very imperfect. The peasants of eastern Russia, as well as some agricultural colonists in South America, burn the forest and cultivate the ground for some years, merely to abandon it and repeat the same process every ten or fifteen years. Periodical change of the soil is necessitated by the lack of fertilizer and proper working. It corresponds to the rotation of crops in scientific farming. When one clearing is abandoned, another is opened, and, since the products cannot be abundant owing to inadequate preparation of the soil, the cleared areas are large compared to the small number of people to be supported by them. But such areas are in no sense comparable to those under intensive cultivation. They have the character of oases scattered through the unexplored forest and are exposed to its perils. Wild animals, for instance, may destroy in a few hours the fruits of prolonged toil. The size of the clearing may also depend on the need of the crops for light and space.

Exploitation of Forests the Chief Cause of Their Disappearance

Extensive as this form of agriculture may be, it in itself would not be sufficient to have reduced the forested area of the world to its present size. It is the increased need for the products of the forest itself, particularly its timber, that has made the heaviest inroads upon it. Next to food, wood has

[60] Lorenzi. *op. cit.*, pp. 155, 157.

been one of the most important factors of civilization, particularly at the time when iron, brick, and other structural materials were either unknown or little used.

In the early stages of economic development, the forests furnished man with fuel for overcoming the rigors of winter cold. It furnished fuel also for metal working, and a number of secondary products such as charcoal, pitch, ashes, gallnuts, some of which were more widely used in the past than they are now. In places where intense cold causes a heavy growth of fur on the wild animals, man has made use of materials produced in the forest for tanning the hides, thus providing himself with clothing and with covering for his primitive tents. At a higher stage of civilization and with the development of means of communication and transportation the products of the forest are no longer merely the means with which to satisfy immediate needs; they become commodities of widespread use far beyond the forest boundary. Many industries which were dependent upon wood as fuel found their location in the forest. Thus the occurrence in the same areas of forests and mineral deposits gave rise to metallurgy and the art of glassmaking. In France about the fifteenth century, before the invention of high ovens, metallurgists and glassmakers took up their abode in the forest. In the Middle Ages an entire forest population employed exclusively in industries growing out of the use of wood lived in the forests of France. Kilns, charcoal furnaces, forges, glass furnaces, limekilns, and establishments where wood was worked up gave a peculiar aspect to the forests of that time.

Pallas describes the metallurgic industries connected with the forests of Russia in the Ural Mountains from which the necessary charcoal was obtained. In the forests of Russia also the coexistence of fur-bearing animals and plants producing tanning material has given rise to village industries, chiefly tanning.[61] The forests of the eastern United States were once extensively used for charcoal making in connection with the iron industry.

Rivers as an Aid in Exploitation of the Forests

The penetration of the forests and the development of forest industries have been greatly favored by rivers. Watercourses penetrating forest regions are the natural means of access and with their banks constitute the first zone of attack on the phalânx of the forest. This was the case in Europe; the Rhine and its tributaries formed the principal routes by which extensive openings could be made in the German forests, and in the time of the Romans special corporations transported the felled trees on rafts.[62] The same was true in Italy during the Roman epoch, when the Aniene, the Liri, and the Chiana served as means of transporting wood from the Apennines, and wood from the Alps reached Rome by way of rivers and the ocean.

The vast territory included between Hudson Bay and the Saskatchewan

[61] Lorenzi, *op. cit.*, pp. 159–162.

[62] L. F. A. Maury: Les forêts de la Gaule et de l'ancienne France, Paris, 1867, p. 79.

River was revealed to missionaries and fur dealers—*voyageurs, coureurs de bois*—by way of the St. Lawrence River. The development of our lumber industry in the early days would not have been so rapid had it not been for the proximity of the New England forests to the coast and the large number of navigable streams, such as the Penobscot, St. John, Androscoggin, St. Croix, and others. Wherever roads are lacking, wherever the rivers are not navigable, the forest cannot serve broad economic ends; in that case the primitive organization remains and the forest furnishes only a local means of livelihood, as is the case in the interior of continents or at high elevations.

In northern Russia forests are still intact because of lack of railways and roads; while the inland location and lack of communication with the coast, together with the long periods during which the rivers are frozen, present obstacles to the development of a wood-exporting industry. Much more favorable are the conditions in the adjoining Scandinavian peninsula, where from the time of the earliest commercial relations with neighboring countries forest products have played a very important part.

The modern development of railroad systems, however, is reducing transportation by water in many regions. Thus in the Vosges Mountains, as well as in our Lake states and Pacific Coast states, transportation by water is dying out altogether.

Psychological Influences

The psychological influence of the forest on primitive peoples has already been noted. At higher stages when man sets himself to overcome the forest he feels its influence none the less surely. Many of the specific pioneer traits of our own original settlers in this country may be traced to their battle against the forest on the slopes of the Alleghanies to provide a place for settlement. The hazardous work of hewing farms out of the virgin forest has bred a race of men of sturdy character and of enormous enterprise and self-reliance. It is true that life in the forest was not conducive to the cultivation of the graces of life characteristic of high culture. The virtues of the backwoodsman were those of a strong animal nature—courage, pertinacity, resourcefulness. In the delightful "Letters from an American Farmer," by J. Hector St. John de Crèvecœur written in 1783, we find a realistic description of the influence of the forest environment upon the character of the so-called back settlers.

> It is with men as it is with the plants and animals that grow and live in the forests; they are entirely different from those that live in the plains. . . . By living in or near the woods their actions are regulated by the wildness of the neighborhood. The deer often came to eat their grain, the wolves to destroy their sheep, the bears to kill their hogs, the foxes to catch their poultry. This surrounding hostility immediately puts the gun into their hands; they watch these animals, they kill some . . . they soon become professed hunters. . . . The chase renders them ferocious, gloomy, and unsociable.[68]

[68] Everyman's Library edit., pp. 51–52.

In spite, however, of coarseness and even brutality, these people were undeniably men. No weaklings were produced by the life of the forest. The boundless woods with the long stretches of swamp land, the rough trails, the isolated homesteads sometimes miles away from the nearest neighbor bred unwillingness to co-operate with others for common purposes or to submit to any kind of discipline.

During the slow process of hewing their farms out of the forest the settlers were compelled to rely for many necessities on their own skill with the ax. From the forest they obtained all the material for the construction of their cabins from the puncheon floor to the shingles of the roof and the moss that calked the crevices of the walls. All these, together with the rude furniture, they got from the trees on their homesteads. The forest also supplied them with meat to vary the monotony of salt pork, itself made from hogs that found every bit of nutriment in the spontaneous products of the forests.

The back settlers, however, in the course of time lost much of their coarseness and produced leaders such as Henry Clay, Jackson, Benton, Cass, and scores of others, who for over half a century helped to shape the destiny of their country. In Abraham Lincoln this type of leader, purged of all the repulsive characteristics of the early type, found its highest expression. The old characteristics of the back settlers disappeared in him and "nothing remained but the pure metal—strong, keen, tempered to perfection, and yet at other times as soft and pliable as gold without alloy." [64]

The entire ancient history of Sweden may also be reduced to the same struggle with the primeval forest. It is the colonization of the forests of northern Russia that has developed in the Russian people the necessary qualities which enabled them to spread to Siberia and take possession of it.

If of all the present nations the Anglo-Saxons, the Teutons, and the Russians display the great colonizing capacity, may it not be attributed largely to their original impenetrable forests, in the struggle with which they have developed the persistence and unrelenting energy required for pioneer work?

Deforestation and the Progress of Civilization

With the growth of population and the spread of civilization the world's forested area has been progressively reduced. At present there is still under forest about five billion acres; if the brush land is included, considerably more, probably one-fourth of the entire land area. About another fourth of the land surface is covered with desert and tundra, which must be excluded from the possible area of human habitation. Therefore the land area available for human activities is none too large. If we compare the relative amount of the land under forest in the different regions of Europe which have comparable climatic and other conditions for timber growth, we find that

[64] Ernest Bruncken: North American Forests and Forestry: Their Relations to the National Life of the American People. New York. 1899. p. 46.

England has only 4 per cent of its land in forest; France, 18 per cent; Belgium, 17 per cent; Germany, 26 per cent; Austria, 30 per cent; Russia, 32 per cent; Sweden, 40 per cent; and Finland, 60 per cent. These figures express also, although in inverse ratio, the relative density of population in these countries. In these figures as in a mirror, is reflected the progressive movement of human civilization.

Other factors may undoubtedly act as a modifying influence. Legal protection of woodlands may have had some effect in preventing indiscriminate deforestation as agriculture, commerce, and industries have developed; but in a broad way the extent to which the forest is cleared is in direct relation to the density of population and therefore to the conditions of civilization.

While it would be misleading to lay down, as a general law, without any qualification, that the decrease in forested area and human progress always go hand in hand, it is nevertheless true that up to the present time the countries having the most highly developed economic organization have also a greater population and a proportionately reduced forest area. This was true in ancient times as it is true now. Thus, for instance, the deforestation of ancient Greece at its highest period of development had progressed much farther than that of the southern end of the Apennine peninsula—at that time in a lower stage of development. The Hellenes then looked upon Italy as a densely forested country. Thus Alcibiades, exiled from Athens, in the discourse delivered to the Lacedaemonians, urging them to aid Syracuse, which was menaced by the Athenians, advised: "build many triremes in addition to those we have, for Italy has wood in great abundance."

Reforestation Following Decline of Civilization

As the progress of ancient civilization, of which agriculture was an essential part, tended to the destruction of the primeval forests, so conversely, with the passing of this civilization, with the decadence of empire and the return to barbarism, the forests, aided by pestilence and devastating wars, gradually restored themselves. In a most striking description of the devastation of Italy Lucan states that brambles and trees spread over untilled ground at the time of the Antonines. After Venice was invaded by the Marcomanni and after the spread of pestilence accompanied by floods, earthquakes, and swarms of locusts, the population of Italy was greatly decreased, and the forests spread over the abandoned territory. In Roman Italy in the time of Augustus, according to the most probable estimates, the population numbered about 6,000,000, and the area of land under agriculture, which was a combination of field crops with pasture in oak forests, was comparatively large. As this area gradually decreased, the forests, no longer checked by the ax and the depredations of grazing animals, spread again over the natural domain which had been taken from them for agricultural purposes. In the great crisis of the third century desolating wars

further aggravated the conditions. Lactantius, speaking of the exorbitant taxes levied by Diocletian, mentions that the colonists abandoned their fields and that the fields then became covered with forests. Incursions of the forest upon cultivated fields reached to the very walls of the cities and even to the centers of inhabited places.[65]

In his history of the forests of France Maury mentions ruins dug up in the dense forests of the eastern region, and on the top of a ridge near Orleans was found in the midst of a forest a Roman *castrum* destroyed by the Vandals. In the Government of Smolensk in Russia fields and towns abandoned in 1812 as a result of the Napoleonic invasion, and later during the famine of 1840 to 1850, were very soon overgrown by forests. Similar cases are found throughout the United States from Virginia to Florida, where forests sprang up on fields abandoned after the Civil War. Even in New England with the migration of the population westward many abandoned fields have come back to forest and today are being cut over for the second and third times. If the climate is favorable and there is no interference from man a few decades are sufficient for fields to become changed into dense forests.[66]

The Struggle Between Man and Forest

Cook in speaking of the effect of agriculture on natural vegetation in Central America says:

> Many localities which are now occupied by apparently virgin forests are shown by archeological remains to be regions of reforestation. Thus in the Senahu-Cahabón district of Alta Vera Paz relics of two or three very different types of primitive civilization indicate that as many ancient populations have occupied successively the same areas which are now being cleared anew by the coffee planters as though for the first time.
>
> It does not yet appear that any considerable region of forest has been explored in Central America without finding similar evidence that the present forests are not truly virgin growth.[67]

And again, speaking of the evidence of antiquity as exemplified by the crumbling of large earthenware pots of an earlier civilization, he continues:

> We cannot know how long it has taken the pottery to crumble, but we can at least contrast the condition of these decayed pots with other pieces of pottery placed in caves of the same district in later prehistoric ages, which still appear fresh and new, as though recently burned. And yet the bones beside these apparently new pots have also crumbled nearly to dust, and there has been time for the surrounding country to be occupied with old forests of hardwood trees, like true virgin growth.

He also mentions terracing of the land as showing that agriculture was formerly extensively practiced and notes the presence of a type of terrace evidently designed "to hold drainage water and prevent erosion . . . . .

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[65] Lorenzi, *op. cit.*, pp. 48, 49.

[66] *Ibid.*

[67] O. F. Cook: Vegetation Affected by Agriculture in Central America, *Bur. of Plant Industry Bull. No. 145*, p. 16, U. S. Dept. of Agric., Washington, D. C., 1909.

[being] frequently met with in the heavily forested region in eastern Guatemala." [68]

What is regarded by some geographers as evidence of a civilization that had arisen in the primeval forest is nothing but the remains of a civilization which succeeded in clearing the forest; with the decline of this civilization and favored by a warm and moist climate, the forest again took possession of the land.

In regions, however, where the climate is unfavorable or where there is even slight interference on the part of man the return of the forest is slow, the land is either merely run over with brambles and vines or becomes virtually a desert. Thus in the region of Friuli there are ruins of medieval castles destroyed during the last years of the Venetian Republic but not yet overrun by forest vegetation except ivy. Bishop Ennodio relates that the fields of Italy at the time of the wars between Theodoric and Odoacer were stripped of their indigenous covering and were overgrown with thorny plants. In many uncultivated areas which served as pasture during the last centuries of the empire the growth of forests was retarded, if not checked altogether, because pasturage on a large scale, as carried on in many parts of Italy, made it impossible for the forest to re-establish itself. The forests of beech and oak which probably covered the land about Rome in early historical times never returned.[69]

The Original Composition of the Forest Changed by Man

There is another important influence which man has exerted upon the forest. The colonization of forest regions not only reduces the forest area but radically changes the entire structure and composition of the remaining forest. In analyzing the names of places, towns, and cities which are made up of words designating forest trees of one kind or another, one is at once impressed by the large number made up of the names of hardwood trees and the very small number designating pines, spruces, or even fir.[70] Of the geographic names of central Europe which indicate the origin of the settlements in forested regions, nearly 90 per cent point to the existence of broad-leaved forests. One can find any number of names indicating an origin in a locality where linden was prevalent: Lindewiese, Lindenfels, Lindenau, Linden, Lindenhoff. With oak there is even a larger number, of which it is enough to mention: Eichendorf, Eichorst, Eichrodt, Eichenfeld, Eichstat, Eichwald. Birch also takes a prominent part in giving names to many places; as, for instance, Birkenfeld, Birkenhain. Beech is also prominently represented, such names as Buchholz and Buchhorn being very numerous. Ash also contributed to the names of many towns; as, for instance, Eschenbach, Eschweiler. Even alder enters into the formation of

[68] Cook, *op. cit.*, p. 17.
[69] Lorenzi, *op. cit.*
[70] Richard Marek: Zur Anthropogeographie des Waldes, *Geogr. Zeitschr.*, Vol. 18, 1912, pp. 1–15.

geographic names, as, for instance, Erlau. One looks almost in vain, however, for towns or places whose names signify pine or spruce. Once in a while one finds such a name as Tannhausen.[71]

From this it is natural to infer that in the past the conifers had not the same wide distribution that they now have. As far as Germany is concerned, the preponderance of coniferous over broad-leaved trees has undoubtedly been brought about artificially by planting pine and spruce as the most profitable species. It is also possible that the land first cleared was that occupied by broad-leaved forests because of the more fertile soil naturally found under such growth, while the poorer sandy soils occupied by the conifers remained uncleared and unsettled. In Michigan the repeated fires have undoubtedly helped the spread of jack pine and Norway pine at the expense of the hardwoods, just as in the South the scrub pine, loblolly pine, and the slash pine extended their range at the expense of other species also as a result of fires accompanying settlement. In the central Rockies fire has changed many a Douglas fir stand into a lodgepole pine forest. This change in the composition of the original forest is evidenced throughout the entire world. Thus in Sweden, pine successfully competes with fir only in the presence of frequent fires, since on burns it comes up and grows faster than fir. In Europe it is an interesting fact that the pine extends its range parallel with the advance of towns and villages.

Civilization Dominating Forests

Over a large part of the world the forest is now conquered. It is not only conquered, it is exterminated beyond any possible chance of natural recovery. It has now become important to civilization to preserve and restore the forest instead of struggling against it. Out of a land area of some 32½ billion acres there is little more than 5 billion acres remaining in forest—exclusive of brush land—or only one-sixth of the land area. The greatest change of course has taken place in Europe, where of a total land area of nearly 2½ billion acres there remain now barely 750 million acres in forest. Even of this, two-thirds are found in European Russia and Finland and about 250 million acres in the rest of Europe. In some countries—Great Britain, for instance—nearly 95 per cent of all the original forest is gone. In France, Spain, Belgium, Rumania, and Greece, from 80 to 90 per cent of the original forest has been destroyed; in Bulgaria, Serbia, and European Russia exclusive of Finland, from 60 to 70 per cent; and in North America the original forest has shrunk from some 822 million acres to 463 million acres in the course of three centuries.

The Increasing Need of Wood

The disappearance of the forest, however, has not done away with the use of wood by the present civilization; on the contrary it has only inten-

[71] The situation is similar in Britain. See Kate Qualtrough: Mythology and Mankind, *Journ. Manchester Geogr. Soc.*, Vol. 34, 1918, pp. 31–50; reference on p. 35.

sified it. Although steel, brick, and concrete are now more and more taking the place of wood for structural purposes, industries are arising every day which are dependent upon wood as raw material. As a striking illustration may be mentioned the pulpwood industry which within a few decades has assumed enormous proportions. In 1880 the consumption of pulpwood in our own country was barely 300,000 cords; twenty years later the consumption had grown to 2,000,000 cords; in ten years more this had more than doubled, and at present it has grown to around 6,000,000 cords. In Great Britain the total consumption of lumber during the period 1851–1911 increased fivefold, and the per capita consumption has also steadily increased, being in 1911 more than three times what it was 60 years before. In spite of the fact that production from German forests has doubled in volume within the past century, the imports from other countries have steadily increased in amount. While there are factors, such as the preservative treatment of wood and the substitution of other materials for construction purposes, which may tend to check the consumption of timber, it is a feature of modern commercial progress that, in spite of this, consumption per capita is steadily increasing.

Not only are the densely populated countries of Europe making heavy importations of lumber and other forest products. In our own country large sections like the Northeast and the Lake states, which not long ago had enormous forest areas and supplied the needs not only of the entire country but of other countries, are dependent upon wood from other regions, such as the Southeastern Pine Belt and the Pacific coast. This wood has to be brought from distances even greater than those over which some of the European countries are now importing. Backward countries in various parts of the world are now being called upon more and more to meet the growing deficit of wood in the world. Armed with powerful logging machinery and highly developed means of transportation the timber trader invades the remaining primeval forests and re-enacts there the same process which the European countries had gone through centuries ago—only at a more accelerated rate.

Social and Economic Evils of Forest Devastation

The clearing of the forest, aside from depriving the thickly settled and highly civilized countries of timber needed for their industries, has produced other bad economic and social effects.[72] The stripping of the mountain forests resulted in the occurrence of torrents, in erosion, in floods, and in a general change in the régime of streams. The disappearance of the forest has also affected the climate and with the growth of industrialism has resulted in the physical deterioration of a large part of the population. Much of the forest land that has been cleared on mountain slopes, sandy plains, or

[72] The case has been well put by S. T. Dana: Forestry and Community Development, *U. S. Dept. of Agric. Bull. No. 638* (contribution from the Forest Service), Washington, D. C., 1918, abstracted in the *Geogr. Rev.* Vol. 5, 1918, pp. 497–498.

rocky hills has proved unsuitable for agriculture and has failed to provide room for permanent settlement. Just as in the past the primeval forests proved a barrier to human settlement, today it is the vast stretches of cut-over and burned-over forest lands, unsuited to agriculture which are an economic barrier to permanent settlement in many parts of the United States, Canada, and other new countries. In the United States alone there are over 80,000,000 acres of such idle waste land. The soil too poor to maintain purely agricultural communities and the lumber industry gone with the disappearance of the forest and therefore no longer a source of livelihood to the local population—there is nothing left to keep the settler on the land. The dreary wastes, dismantled sawmills, deserted towns, so common throughout the Lake states, Pennsylvania, and other sections of the East, are depressing reminders of the day when these regions were the centers of lumber production for the entire country and sustained prosperous communities.

The products of the forest have now become altogether too valuable and no civilized nation can afford forest devastation on a large scale without regard to the future possibilities of the land. The demand for forest products is now so great that the cutting away of the forest, even on fairly good agricultural land, is far in advance of the possibility of actual land settlement. If the cutting is not followed by another forest growth or the land is not taken up by settlers for cultivation, the result is an economic waste and reduced production of the primary necessities of life.

Practically all of the civilized countries of the world have now come to realize that there is a point beyond which further clearing of the forest, no matter what the density of the population may be, proves detrimental to progress itself. Europe reached that point several centuries ago.

In central Europe the period of the greatest clearing of forest land for settlement was practically completed by the end of the thirteenth century, although considerable clearing has taken place since then in the more remote districts and particularly in the Alps. In the Canton of Zurich it is very definitely established that for the last 250 years the forest area has been reduced only 2.85 per cent. Better agricultural methods which made it possible to produce larger crops on smaller areas and the apparent evils resulting from the destruction of forests on mountain slopes led to adoption of legislative measures for the purpose of checking further clearing of forest on non-agricultural land.

The lesson of the older countries found a reaction also in countries still having abundant forests. In practically the entire civilized world a new economic force has now been born—a general appreciation of the value of forests and a movement toward the introduction of rational forest management. There is no doubt whatever that in civilized countries there is enough accessible actual and potential forest land not suitable for agriculture to produce under proper management timber enough to supply indefinitely the world's great demand.

The New Movement Toward Rational Management

Nearly every civilized country at the present time has adopted or is considering measures for the perpetuation of the existing forests, or even for extending their present area. Thus England which, because of her insular position and proximity to countries still possessing vast forest areas and because of her cheap water transportation, could best of all get along with a small forest area has now, as a result of bitter experience during the war, worked out a plan for planting some 1,700,000 acres and providing a forest area sufficient to sustain her domestic needs in case of emergency for three years. France, which for over a century has been carefully husbanding her forests, is further elaborating plans for their careful management and is enlarging her forest nurseries for extensive planting. Germany, Switzerland, Italy, Norway, Sweden, and New Zealand are also considering means of increasing forest products. Even in our own country the maintenance and protection of existing forests has become a pressing question of the day.

Nearly all of the forests now found in western Europe are man-made. With increase in population more intensive use of all resources became necessary, especially of those resources which through more intensive application of labor, knowledge, and skill could be made to produce more fully. Forests being a poor-land crop prove more profitable than agricultural crops on non-agricultural lands. The day of the forester—the timber farmer—has now arrived in practically all densely populated countries of the world, and his work is to secure forest crops by human skill just as food crops are now being secured. Nor is the less material rôle of the forest being overlooked. In order to offset deterioration in the physical and ethical well-being of the people crowded in industrial centers with poor housing facilities, state and municipal forests are being established as a source of healthy recreation for the densely populated countries of Europe.

The new forest may be different from the original forest which once occupied the ground. It certainly bears a more utilitarian aspect. The trees that are being grown are not always of the kind that nature would prefer to produce under given conditions of climate and soil, but are those which man needs most. Just as intensive farming has increased the production of the land, so the forester is now producing five to ten times as much useful material as nature unaided produced before. Although the man-made forest may not have the beauty and grandeur of the wild woods which were the result of the free play of natural forces, it has a new beauty—the beauty of orderliness and usefulness. It is no less an important factor in civilization from the ethical and geographical point of view, because at present the economic principle is applied to it, as it is now being applied to the raising of agricultural crops.[73]

[73] B. E. Fernow: The Relation of Forests to our Civilization, *Journ. of Agriculture*, Univ. of California, Vol. 4, 1916, p. 76.

THE REGION OF MAXIMUM INACCESSIBILITY IN THE ARCTIC

By Vilhjalmur Stefansson

Most people imagine that the degree of inaccessibility of polar regions depends mainly on latitude. This is not true, nor is the problem so simple that it can be stated briefly. Neither are the facts sufficiently known as yet for a final and correct answer. But we do understand many of the conditions that modify the problem and an approximate statement of them is possible.

The main condition that determines the comparative accessibility of points within the polar regions is the configuration of the lands and their effect upon the ocean currents. The great oceans, the Atlantic and the Pacific, are similar in that each has its own warm current, but they differ fundamentally in this: that the Japan Current of the Pacific is effectually shut out from the Arctic on that side by the chain of the Aleutian Islands, so that instead of flowing north into the polar sea to melt away the ice, it expends its heat chiefly along the coast of southern Alaska and the western coast of Canada and the United States, profoundly modifying the climate of those regions. But in the Atlantic the Gulf Stream flows unhindered northward through the wide and deep gap between Norway and Greenland, splitting on Iceland and giving it a climate approximating that of Scotland. We may truthfully think of the Gulf Stream as melting away the polar ice (which otherwise would come down to the northern coast of Iceland) with such effect that ships can sail ten or eleven degrees (or seven hundred miles) farther north on the Atlantic side than they can on the Pacific side of the Arctic.

Two Stages of Approach

Up to the present, polar exploration has been conducted in two stages. First, men sail towards the unexplored area as far as they can go in ships. From this point they travel with sledges hauled by dogs or men and in some cases by both.

In connection with this article I have prepared a map showing graphically, although with only approximate correctness, the comparative accessibility of various points within the arctic regions. The most northerly points known to have been attained by ships under sail or steam have been plotted on this map, and lines have been drawn connecting these points. It is possible that in certain places a ship could sail a little farther north; but no ship has as yet done so, and in general we may consider this the area "inaccessible to ships."

Beyond the farthest points yet attained by ships the exploration of the polar regions has been carried on mainly by men or dogs drawing sledges

loaded with supplies upon which both men and dogs depended for subsistence. In some cases the length of the journey has been somewhat extended by the killing of the dogs originally used as draft animals and the conversion of their flesh to use as food either for the remaining dogs or for the men.

The "Pole of Inaccessibility"

It will be generally conceded that the best journey so far made by this method was that of Admiral Peary from Cape Columbia to the Pole. This is a linear distance of about 500 geographical miles. To show graphically some of the points that by this method have an inaccessibility comparable to that of the Pole itself, a distance of 500 miles has been allowed for along the meridians on which Nansen, DeLong, Collinson, and others attained their farthest north by ship, either under steam or sail. These positions are marked on the map by dots enclosed in small circles. From the dots have been drawn arcs of circles of 500-mile radius. The intersecting arcs delimit the inner border of a zone of "comparative accessibility" considered from the point of view of a system of exploration similar to Peary's. The area enclosed by the intersecting arcs—stippled on the map—is the area of "comparative inaccessibility." Any point within it is less accessible than the North Pole. The average rate of Peary's travel was about 12 miles a day, so that in five days a distance of sixty miles was covered. Isochronic lines representing this distance have been drawn within the area of comparative inaccessibility. The center—determined by the intersection of arcs with centers at the ships' positions of Peary, Berry, and Nansen—is the "Pole of Inaccessibility." It is the point within the arctic regions most difficult of access for any explorer who first goes as far as he can by ship and then pushes forward by the use of men and dogs hauling sledges.

When the time of exploration by airplanes or dirigibles shall come, this map will still express roughly the comparative inaccessibility of various points within the polar regions, for the presumption is that such flights would be made from bases established by ships under steam. Of course, it will eventually become possible to fly direct from any such city as New York or London to any point within the northern hemisphere, and for such undertakings this map will have no significance.

Factors Modifying the Theoretical Results

Should anyone desire to use this map as the basis either for the planning of an actual polar expedition or for the illustration of theories upon the subject, he will have to bear in mind various modifying factors, the most important of which are the following:

1. When traveling over the surface of the mobile north-polar ice the first difficulty is with currents. For instance, it is possible to sail comparatively near the North Pole in the longitude of Spitsbergen; but Parry and most of his followers found that when they strove to march north in this region their

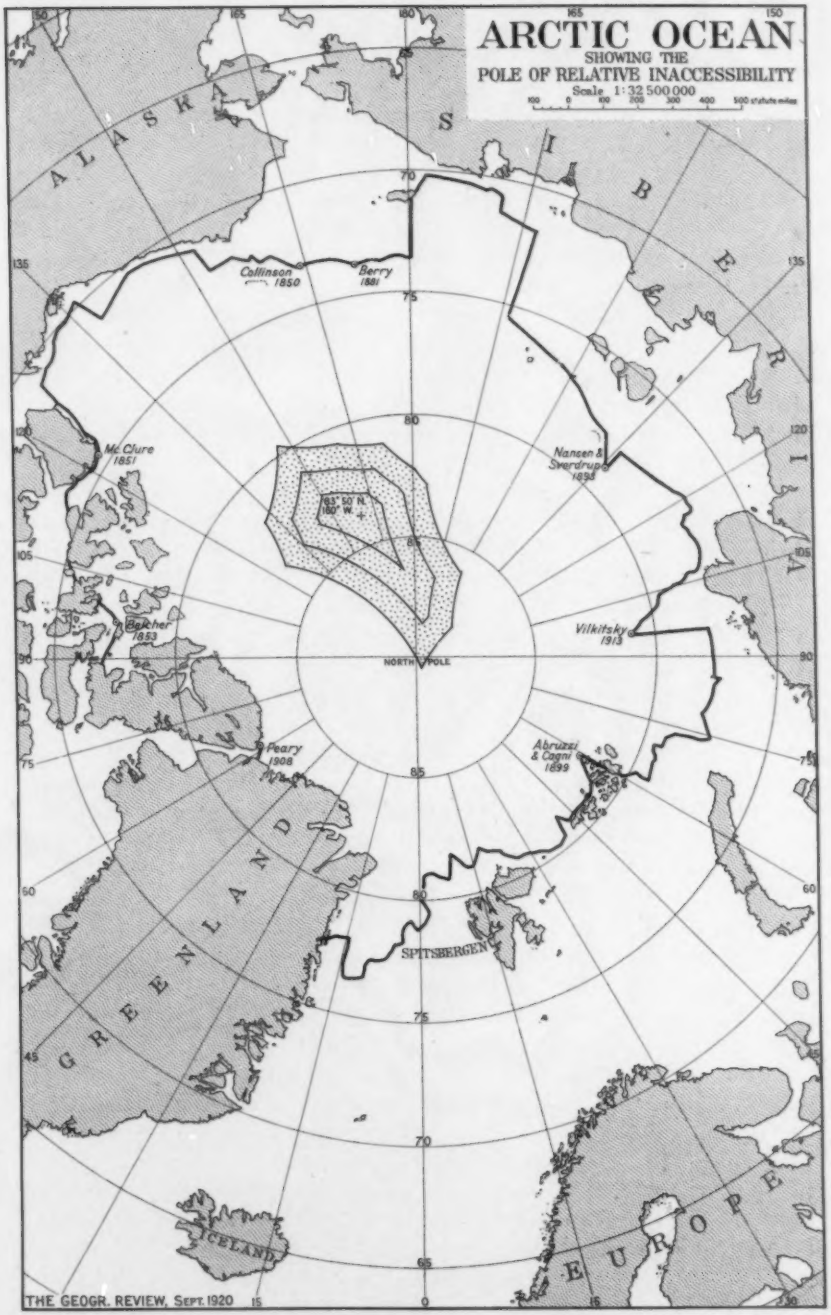

FIG. 1—The entire area outside of the heavy solid line may be called the "Zone of Approach by Ship;" the area within it the "Zone of Man-and-Dog Travel." The stippled portion of the latter is the "Zone of Comparative Inaccessibility." The distance between the isochronic lines is five days dog-sledge travel or 60 miles. Incidentally the map shows the superiority of Peary's position of 1908 over all others on land as a base for a dash aimed at the point of latitude 90° N. It is also favorably situated for an attack on the "Pole of Inaccessibility," which is only 200 miles farther away from Peary's base than the North Pole.

efforts were in part cancelled by the continuous southward drift of the ice over which they were traveling. Our own work has shown that a similar southward drift, although perhaps not so strong a one, would have to be faced by anyone traveling north near the 138th meridian W. To the north of Grant Land Peary found an eastward drift though it did not handicap him materially. It is probable, on the other hand, that anyone starting north from Wrangell Island or the New Siberia Islands would get considerable help from a current running partly in his favor.

2. At times an even more serious handicap than an adverse current is the frequency of open leads. Judging from the narratives of polar explorers, this particular handicap is most serious in the region north of eastern Siberia, where Baron Wrangell traveled a century ago, and in the belt of generally similar conditions north of Alaska with which I have personal acquaintance. This handicap is of little weight northwest of Prince Patrick Island, as I have found by experience, and northwest of Cape Thomas Hubbard and north of Cape Columbia, as shown by the narratives of Peary and MacMillan.

3. In regions where currents are violent the ice is broken up with a resulting formation not only of the leads of open water which we have considered, but the heavy pressure ridges which make sledge travel more arduous and occasionally compel actual road making with pickaxes. The trouble with pressure ridges is generally greatest near land and becomes less and less as one goes farther from shore. They are the more troublesome the younger the ice. It seems now fairly clear that much of the polar ice is formed originally on the American and Siberian side of the Arctic and drifts across past the northern end of Greenland towards Franz Josef Land where it vanishes in the Gulf Stream.

This is one of the many reasons which made Peary's "American route to the Pole" the most desirable. Not only could he sail farther north by ship and then have comparatively few leads to contend with, but he had the added advantage of traveling in considerable part over ice which had been formed many years earlier, perhaps in the Beaufort Sea, and had been drifting towards Greenland and gradually thickening season by season until it was comparatively smooth and stable.

4. We have now considered the main points which must be kept in mind in interpreting the rather rigid data of the map. There remains a matter which was of little consequence to Wrangell, Nansen, or Peary. In their work they counted little upon replenishing their stock of food and fuel and thus making their journeys longer and easier through the killing of local animals, such as seals, polar bear, or fish. The presence of these, except near land, was either unsuspected or ignored; it formed no basis of their calculation and did not in practice affect their results materially. But in the system of "living off the country"[1] the animal life of the region is vitally important.

[1] Vilhjalmur Stefansson: "Living Off the Country" as a Method of Arctic Exploration, *Geogr. Rev.*, Vol. 7 1919, pp. 291–310.

The Question of Food Supply

From my study of north polar conditions I conclude that the amount of animal life has no direct relation to latitude. We have already seen that the North Pole by no means corresponds to the Pole of Inaccessibility which is distant from it by more than 400 miles. The North Pole lies, therefore, towards the edge of the area that is difficult of access through being covered with floating ice. It might seem more reasonable to suppose, then, that the amount of animal life would vary with distance from the Pole of Inaccessibility, but that does not seem to be the case either.

In the present discussion we shall ignore all forms of life except the seal, for this is the only animal upon which it appears practical to rely. We have seen whales and fish as far from land as we have seen seals, but in planning a journey over the ice I think it unlikely that I should ever trouble enough about animals other than the seal to carry equipment for securing them. It is probable that seals have no great difficulty anywhere within the polar area in securing food and that the most serious condition they have to fight is the massing of the ice in such a way that they cannot come up to breathe. In the summer it can be assumed that most of the seals are in open water; that is, they are either living in neighborhoods where there are scattered ice cakes like islands in a sea of water or else where there are open leads running like great rivers across the ice fields. In autumn the water of the leads will freeze over, at first with a thin ice that can be easily broken; but when this ice gets to be four inches or more in thickness the seal has to keep open a breathing hole by gnawing. Seals that live in comparatively level bay ice near land (and the same is doubtless true of seals living under level patches of ice on the ocean) have commonly several breathing holes, perhaps half a dozen or more, scattered over two or three acres of area. These holes are of necessity cigar-shaped, so as to admit the body of the seal when the ice gets several feet thick. The actual breathing hole to the surface is the size of the mouth of a water tumbler, or even smaller, and may be covered with snow. Presumably the seal, in looking up when swimming about in the water, can see light patches where his breathing holes are, and thus he is enabled to find them again after having descended to feed. He does not have to go deep to feed, for he lives mainly on the floating animal life near the surface rather than on fishes, although he gets a few of these also. He is stationary with reference to his breathing holes but continually moving with reference to the sea bottom and traveling in the same direction as the ice under which he lives.

It has been understood now for decades that a ship that freezes in the ice near Wrangell Island or the New Siberia Islands will arrive three or four years later in the ocean north of the Atlantic. Similarly, a seal that finds himself in the vicinity of Wrangell Island in the fall of a certain year will, in all probability, find himself two or three years later in the vicinity of Spitsbergen. Assuming that the ice that drifts across the Pole of Inaccessi-

bility, or the North Pole for that matter, was originally formed in the Beaufort Sea where seals are known to be abundant, it will follow that a certain number of seals are continually being carried across either Pole.

"Ice Deserts"

But there are undoubtedly in the Arctic certain "ice deserts." These are regions similar to the Sargasso Sea. In them pressure due to winds or currents operating from a distance heaps the ice up, and it may even remain in an eddy for years. We found one such region north of Prince Patrick Island. Seals were not absent but they were comparatively rare, and they became more numerous again when we got farther north. On coming to such an ice desert the traveler who depends on some method similar to ours, where the main reliance for food and fuel is upon seals, will find that he is face to face with a problem similar to that of a traveler who, in crossing an unknown continent in tropical or temperate regions, finds himself gradually entering a desert produced by lack of rain. Such a traveler overland would have to depend upon his judgment. He might avoid the desert by skirting it; he might turn back, giving up his journey for the time being; or he might make a dash across, hoping that his resources would take him to the farther side of the hostile area. Just such a problem one would have to face in ice travel on coming to a region where an eddy existed and where massed ice had evidently persisted for years.

That is, it would be a problem to a party trying to live by forage. To a company using the Peary pemmican-and-relay system it would constitute no problem at all. They would care about the smoothness, stability, freedom from leads of the ice, and under these heads they might find the conditions excellent—they probably would. For the presence or absence of seals beneath their feet they would care not at all.

But for those who count on getting their food and fuel as they go, these ice deserts are the one source of gravest concern. We cannot tell in advance for certain where we shall find them, for we can reason only on the basis of what we know and in the Arctic there are still many things unknown. When we come to the edge of such deserts we can guess only very roughly at their extent or in what direction the diameter will be least. They are, in the system of "living by forage," the most serious source of danger, although the mere understanding of their existence lessens the danger.

NEW MONTHLY AND SEASONAL RAINFALL MAPS OF THE UNITED STATES*

By Robert DeC. Ward

Harvard University

Introduction

In studying any series of monthly and seasonal rainfall maps, it is important to remember that no single chart represents a fixed condition. Each shows a transitional stage between the rainfall of the preceding and that of the following map. The most vivid, as well as the most accurate, conception of the distribution of the rainfall throughout the year is gained by viewing the successive maps as if they were a set of stereopticon pictures. Each picture develops out of the preceding one and dissolves into that which follows. The best way to gain this view is to hang the whole series of maps on a rack, or, if the maps are of small size, to have them all printed or mounted on one sheet. Each chart should then be thought of as a "snapshot" of constantly fluctuating conditions.

It is by no means difficult to familiarize oneself with the essential characteristics of each month's rainfall. The outstanding features may easily be remembered if the types and the chief controls of rainfall are held in mind. Indeed, it almost immediately becomes possible to name the month or season whose rainfall is shown on any chart, although the designation of the map be concealed. This method of study has been successfully used for the past twenty-five years in the writer's course of lectures and laboratory work on the climatology of the United States. For ordinary purposes, in any general study of climatology, only the more important features of the seasonal and monthly rainfalls need consideration. Details as to the actual amounts of rainfall are difficult to remember. A discussion of them is out of place here. Furthermore, such details may readily be secured, when needed, from the official publications of the Weather Bureau.

In a general survey of rainfall distribution throughout the year the seasonal maps may best be taken as the basis of study. They show the larger facts. They cover divisions of the year which are universally recognized as logical and as having human and economic significance. Further, they sufficiently emphasize the essential characteristics of the varying rainfall in different parts of the year without the risk of the confusion which is not unlikely to result from a detailed study of the twelve monthly maps. The latter should, however, by no means be discarded.

* This is the sixth in a series of articles by the present writer on the climatology of the United States. The previous articles were: Climatic Subdivisions of the United States, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 672–680; Rainfall Types of the United States, *Geogr. Rev.*, Vol. 4, 1917, pp. 131–144; Rainy Days and Rain Probability in the United States, *Geogr. Rev.*, Vol. 7, 1919, pp. 44–48; Frost in the United States [a review], *Geogr. Rev.*, Vol. 7, 1919, pp. 339–344; Cloudiness in the United States, *Geogr. Rev.*, Vol. 9, 1920, pp. 347–356.

The New Charts

Several sets of monthly and seasonal rainfall maps of the United States have been published.[1] There are certain fundamental objections to them. (1) The number of stations for which data were available was limited. (2) The records did not cover a uniform period and were not reduced to a uniform period. (3) The isohyetal lines were generally drawn with little or no regard to topographic controls. For the climatic section of the "Atlas of American Agriculture" there has recently been prepared a new and very complete series of rainfall charts. The precipitation section of the "Atlas" has not yet been published. In view of a long delay in the issue of the "Atlas," and of the fact that, when it appears, it will not be available for general distribution because of the limited edition necessitated by the high cost of printing, advance publication of several of the new charts has been thought advisable. Thus, the new chart of mean annual precipitation was issued, as a separate "advance" sheet, in January, 1917, and was later also included in the *Monthly Weather Review* for July, 1917.[2]

More recently, the full set of new monthly and seasonal charts, later to appear in the "Atlas," has been published, in the *Monthly Weather Review*

Lorin Blodget: Climatology of the United States and of the Temperate Latitudes of the North American Continent. 536 pp.; maps, diagrs. Philadelphia, 1857. [Rainfall maps for the year and the seasons.]

[1] C. A. Schott: Tables and Results of the Precipitation, in Rain and Snow, in the United States; and at Some Stations in Adjacent Parts of North America, and in Central and South America. *Smithsonian Contributions to Knowledge, No. 222*, Vol. 18, pp. 1–175; maps, diagrs. Washington, D. C., 1872. [Rainfall maps for summer, winter, and year.]

Idem: 2nd edit. *Smithsonian Contributions to Knowledge, No. 353*, Vol. 24, pp. i–xx and 1–249; maps, diagrs. Washington, D. C., 1885. [Charts for year and for four seasons.]

H. H. C. Dunwoody: Charts and Tables Showing Geographical Distribution of Rainfall in the United States. 51 pp.; maps. *U. S. Signal Service Professional Paper No. 9.* Washington, D. C., 1883. [Monthly and annual charts.]

Idem: Normal Monthly Rainfall throughout the United States, Based upon 18-Year Normals, Accompanied by a General Description of the Rainfall of the United States. 10 pp.; maps. U. S. Signal Service, Washington, D. C., 1889.

A. W. Greely: American Weather. 286 pp.; maps. New York, 1888. [Charts XIII–XV, average rainfall for April, May, and June, based on 18 years' observations.]

M. W. Harrington: Rainfall and Snow of the United States, Compiled to the End of 1891, with Annual Seasonal, Monthly, and Other Charts. *Weather Bur. Bull. C.* Washington, D. C., 1894. Atlas and Text. [The monthly maps are reproduced, on a small scale, in "Atlas of Meteorology," 1899, Pl. 24; text, pp. 24–25. The isohyetal lines have been extended into Canada and Mexico.]

A. J. Henry: Rainfall of the United States, with Annual, Seasonal, and Other Charts. *Weather Bur. Bull. D.* Washington, D. C., 1897. [Charts of mean annual rainfall for the United States as a whole, and for the eastern United States for April–September.]

See also B. C. Wallis: The Rainfall of the Northeastern United States; *idem*, The Distribution of the Rainfall in the Eastern United States; *idem*, The Distribution of the Rainfall in the Western United States; *idem*, The Rainfall Régime of the Several States, *Monthly Weather Rev.*, Vol. 43, 1915, pp. 11–14, 14–24, 170–175, 176–178. [In this series of papers the author presents charts showing the rainfalls for each month by lines of equal departure from the rainfall norm, or "equipluves." The norm is the amount of rainfall that would occur at any place on the assumption that such rainfall is evenly distributed throughout the year. In other words, the usual *monthly* rainfall averages are expressed as percentages of the *annual* value at each station. Charts of the wettest and driest months, and of rainfall regions, are given, as well as diagrams of rainfall intensities.]

Idem: Rainfall and Raininess, *ibid.*, Vol. 46, 1918, pp. 229–230. [Gives diagrams showing how to convert "equipluves" into isohyets, *i.e.* raininess into rainfall and *vice versa*.]

[2] R. DeC. Ward: Mean Annual Rainfall of the United States, with Notes on the New Chart of Average Annual Precipitation from the "Atlas of American Agriculture" (Advance Sheet), *Monthly Weather Rev.*, Vol. 45, July, 1917, pp. 338–345; chart. [Noted in the *Geogr. Rev.*, Vol. 5, 1918, pp. 325–326.]

for September, 1919.[3] These new charts mark a very decided advance over all the earlier ones and are now and will for years remain the "standard" series. They are based on a large number of records (3,600). The stations are well distributed over the country. The records were all reduced to the uniform period of 20 years, from 1895 to 1914, about 1,600 cases being actual averages for this period (short breaks being interpolated), and the remaining 2,000 having been reduced to this same period by the method described in the *Monthly Weather Review*, Vol. 45, May, 1917, pp. 333–335. Further, the isohyetal lines were drawn on hachured base maps, and in locating the lines reasonable attention was paid to topographic controls. The scale of the present maps is 1:12,200,000. They are 11 by 7 inches in size. Isohyets are drawn for 0.5 inch, and then for every inch, or for greater intervals in cases where the lines are crowded.

The charts which accompany the present review (pp. 176, 177) show the mean average precipitation over the United States for the four seasons. They were redrawn, with some slight modifications and a few omissions, from the corresponding charts published in the *Monthly Weather Review*.

The Larger Facts Brought Out on the Charts

A general glance at the new maps brings out three striking facts. (1) On the Pacific coast there is a well-defined seasonal migration, northward and southward, of a zone of rainfall which, in some months, may be considered to overlap the Sierra Nevada-Cascade barrier and expand over the northern and southern Plateau areas. These rain conditions are associated with the poleward and equatorward migration of the storm belt, as well as with seasonal changes in temperature over the land which offer the best opportunities for condensation in winter. (2) Over an extended area between the Rocky Mountains and the Mississippi River the rainfall lines advance northward and westward in spring and early summer and retreat southward and eastward in late summer and autumn. That is the conditions favorable for heavier rainfalls move from the Gulf of Mexico up the Mississippi Valley and out over the Plains and then back again. These fluctuations are associated with the development, as the continent warms, of a system of inflowing warm winds, carrying abundant moisture, and with the gradual replacement of this régime, as the continent cools, by a system of outflowing winds. (3) The eastern half of the country shows less difference between the rainfalls in the several months than the western. The districts of greatest fluctuation are along the southern Atlantic and Gulf coasts. In the eastern sections, the decreased cyclonic rainfall of the warmer months is largely or wholly compensated by frequent summer thunderstorms, while along the southern coasts West Indian hurricanes give heavy

[3] J. B. Kincer: The Seasonal Distribution of Precipitation and its Frequency and Intensity in the United States, *Monthly Weather Rev.*, Vol. 47, September, 1919, pp. 624–631; charts. [Brief reference was made to this publication in the *Geogr. Rev.*, Vol. 9, 1920, pp. 67–68.]

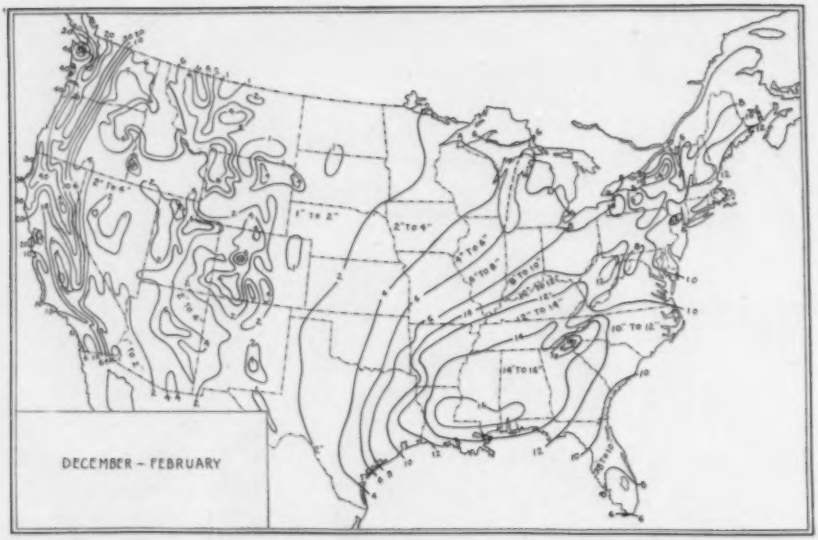

FIG. 1—Map showing the average winter rainfall of the United States. Scale, 1: 45,000,000.

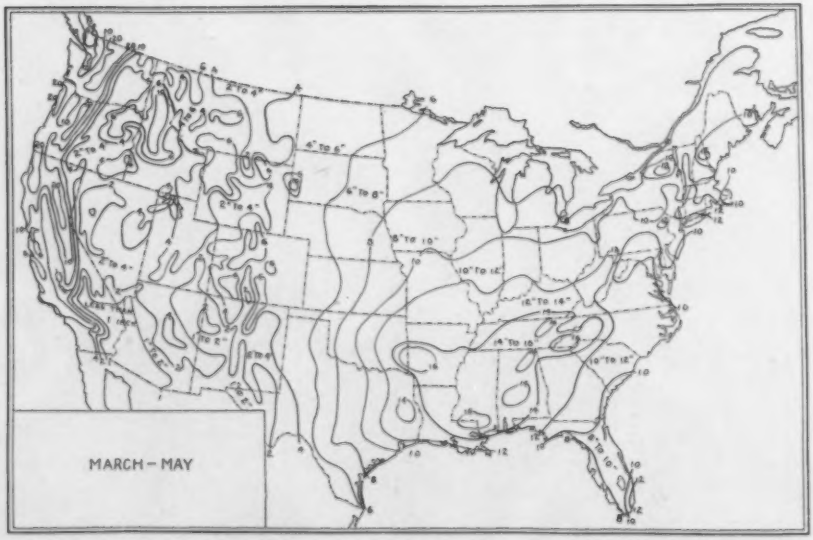

FIG. 2—Map showing the average spring rainfall of the United States. Scale, 1: 45,000,000.

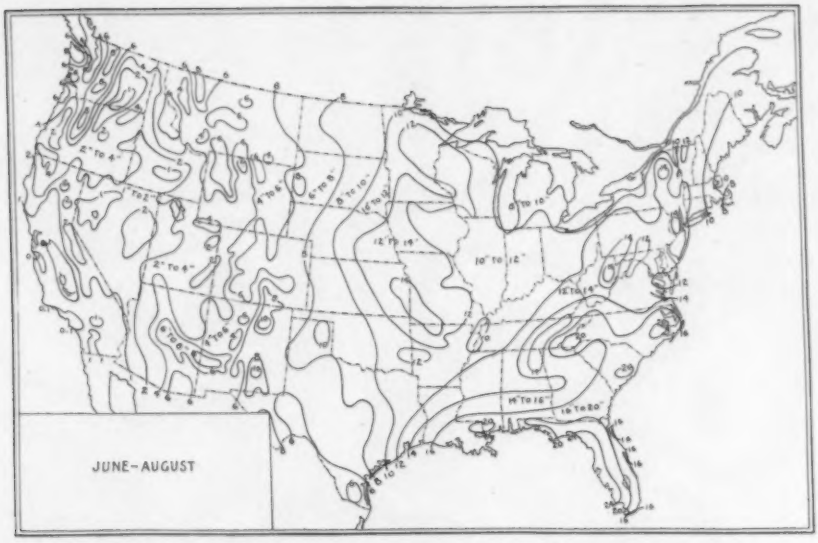

FIG. 3—Map showing the average summer rainfall of the United States. Scale, 1: 45,000,000.

FIG. 4—Map showing the average autumn rainfall of the United States. Scale, 1: 45,000,000.

though more or less local and irregular downpours in the late summer and autumn months.

The Pacific Coast [4]

The seasonal fluctuation in rainfall on the Pacific slope is, on the whole, the most striking feature on the charts. When the four seasonal charts are examined in their logical order, the winter maximum is seen to grade through a spring with decreasing rainfall to a summer minimum. Autumn follows with a general increase over the whole slope. This is the type of rainfall known as the "Pacific." [5] The topographic influences upon the seasonal amounts stand out with remarkable distinctness. In winter considerable portions of the Cascade and Sierra Nevada Mountains have over 30 inches. The northern portion of the Coast Range locally has over 40 inches, with over 50 inches on Mt. Olympus, on the extreme northwestern coast of Washington. The valleys and lowlands have distinctly less rainfall. In Washington and Oregon most of the lower land is enclosed by the 20-inch line, while farther south the Great Valley of California averages below 20 inches; much of it has less than 10 inches, and the southern portion even less than 5 inches. On the immediate seacoast the winter rainfall decreases from north to south from 30–40 inches to less than 6 inches.

Summer is the driest season. The maximum rainfalls on the mountains are nowhere 10 inches, even in the north, while the valleys have roughly 2–4 inches in the north and under 0.1 inch in the southern portion of the Great Valley of California. Spring and autumn are intermediate seasons and have intermediate amounts of rainfall. This marked seasonal migration, poleward and equatorward, of the rainfall conditions on the Pacific coast is still better illustrated on the monthly charts.

From March to July and August there is a striking and interesting withdrawal, up the Pacific coast, of the zone of winter rains, dependent upon the northward retreat of the storm belt and upon the gradual warming of the land. By April the maximum monthly rainfall on the coast in the extreme northwest, is 6–10 inches; 1–2 inches occur in the region about San Francisco, and 0.5 inch on the southern coast. The 1-inch line on the coast is slightly north of San Francisco in May. In June it is on the northwestern California coast. The July map shows the minimum of the Pacific type, i. e. the extreme northward migration of the winter rains. Only a small area in the northwest and the upper slopes of the Cascade Mountains have rainfalls of more than 1 inch. From August through to December the belt of winter rains is moving southward again. Each month shows an extension of the area covered and an increase in the amount of precipitation. Thus for the central California coast, in the district immediately adjacent to San Fran-

[4] For a map of the climatic provinces which are used as the basis of the following discussion see R. DeC. Ward: Climatic Subdivisions of the United States, *Bull. Amer. Geogr. Soc.*, Vol. 47, 1915, pp. 672–680, Figure 5, on p. 678.

[5] For a discussion of the rainfall types referred to in this article see R. DeC. Ward: Rainfall Types of the United States, *Geogr. Rev.*, Vol. 4, 1917, pp. 131–144.

cisco, this monthly increase is clearly indicated by the following amounts of rainfall: August, a trace; September, 0.5–1 inch; October, 1–2 inches; November, 2–3 inches; December, about 3 inches.

The Plateau Province

The Plateau province lies in the rain shadow of the Cascade-Sierra Nevada ranges. Its seasonal rainfall has both marine and continental characteristics. The cold-season rainfall of the Pacific coast may be considered as extending across the mountains into the western portion of the Plateau, causing the primary or secondary winter and early spring maxima of this interior district, these rains being heavier in the north, where there is the greatest cyclonic activity ("Northern Plateau type"). Over the northern plateaus the seasonal amounts decrease from winter to summer, both on the mountains and also over the lower portions of the district. The southern Plateau has its driest seasons in autumn and spring, with the primary maximum in summer ("Southern Plateau type"). As illustrating these points, the following broadly generalized seasonal rainfall amounts for different parts of the Plateau province are here given.

Table 1 — Seasonal Rainfall in the Plateau Province

Season	Northern Plateau		Southern Plateau	
	Lower Altitudes	Mountains (eastern)	Lower Altitudes	Mountains
Winter	About 4″	6″–10″+	1″–4″	4″–6″
Spring	<2″–4″	6″–10″+	<1″–2″	2″–4″+
Summer	<2″–4″	4″– 6″+	<1″–4″	6″–8″+
Autumn	2″–4″	6″–10″+	<1″–4″	4″+

The Great Plains

The second striking feature on the charts concerns the seasonal fluctuations of rainfall over the Great Plains. In winter the 100th meridian marks about the average western limit of a seasonal rainfall of 2 inches for the eastern United States. In the north, the 2-inch line is well east of the Plains, reaching central Minnesota, while there is a slight extension to the west of the 100th meridian in Texas. The 2-inch line crosses the meridian in Kansas. From month to month as spring advances, the rainfall lines over the great central lowlands move northward and westward from the Gulf of Mexico. The conditions favorable for increasing rainfall progress inland as the gradual heating of the continent develops a system of inflowing, damp winds which, in a sense, carry the rainfall lines with them. In

March the 1-inch line is about on the 100th meridian; in April the 2-inch and in May the 3-inch line occupies roughly this same position. The spring map shows that the rainfall along the eastern margin of the Plains has increased to three times that of winter (6 inches as against 2 inches). This westward migration is at its maximum in June, when there are monthly rainfalls of more than 3 inches over considerable portions of the eastern and northern Great Plains. The charts thus indicate very clearly the progress of conditions which give the spring and early summer maxima of the "Eastern Rocky Mountain Foothills," and of the "Missouri" rainfall types. The pronounced northwestward extension of these rainfall maxima appears in the trend of the rainfall lines in June.

In July the swing of the sun southward after the summer solstice, and the passing of the conditions which gave the early summer maxima, result in a retreat of the rainfall lines eastward across the Plains. This retreat is greatest and most rapid in the north, where the westward advance was the greatest. In the south between, June and July, instead of a retreat there is a distinct extension westward, over New Mexico and Arizona, of rainfall conditions of 2–4 inches. This is the map evidence of the approach of the late summer maximum, due essentially to local convectional rainfalls, of the "New Mexican" and "Southern Plateau" types. The general eastward withdrawal of the rainfall lines over the Plains continues month by month until winter. The seasonal rainfall amounts along the eastern margin of the Plains are as follows: winter, 2 inches; spring, 6 inches; summer 8–10 inches; autumn, 4 inches in the north to 6 inches in Texas. This great seasonal migration of rainfall conditions over the area west of the Mississippi River, over the Great Plains, so clearly seen on the rainfall charts, brings to mind the economic importance of the warm-season rains in that region. The approach of the time of rainfall maximum is anxiously awaited by the farmers. Upon the proper distribution of the rain, in time and in amount, depends the success of agricultural operations over vast areas of these western states.

The Eastern and Gulf Provinces

The third large fact illustrated by the charts concerns the rainfall of the eastern United States. It is apparent that, on the whole, the distribution of rainfall throughout the year is generally more uniform in the east than in the west, although there are certain sections of the country east of the Plains where the seasonal fluctuation is well marked. Thus, the westward migration of the rainfall lines in spring and summer, referred to in the preceding paragraphs, is a striking characteristic of the Mississippi-Missouri Valley region. Other seasonal fluctuations shown on the charts are (1) the winter and (early) spring rainfalls of the "Tennessee type," followed by a drier summer and autumn, and (2) the marked (late) summer and (early) autumn rainfalls along the Gulf and southern Atlantic coasts

("Atlantic," "Florida," "North Gulf Coast," and "Texas" types). The generalized seasonal amounts of rain along the Gulf coast are:

TABLE II—SEASONAL RAINFALL ALONG THE GULF COAST

SEASON	FLORIDA	LOUISIANA	TEXAS
Winter	6″–14″	12″–14″	4″–12″
Spring	8″–14″	12″–14″	6″–12″
Summer	16″–24″	16″+	6″–14″
Autumn	12″–20″	12″–14″	8″–12″+

A comparison of all the charts shows a general decrease over the eastern United States as a whole from the warmer to the colder months. Autumn is on the whole the driest season. It further appears that the rainfall charts for the summer months resemble the mean annual rainfall map somewhat more closely than do the charts for the winter months. The warm-season rains, therefore, are the dominant control in eastern sections. The continental type, of late spring, summer, and early autumn rainfalls, covers a larger area and is more important than the cold-season rains. Some twenty-five years ago Harrington calculated the seasonal rainfalls of the United States as a whole. The rainfall of summer is the heaviest; then that of spring, with winter third, and autumn the driest season. The dominance of the continental type of warm-season rains is thus clearly brought out. Observations now available, covering longer periods and from more numerous stations, would give different amounts but would not alter the order of seasons above named.

THE PEARL FISHERS OF TORRES STRAITS ISLANDS

By Thomas J. McMahon

The islands of Torres Straits, directly north of Queensland, Australia, vary in size from a mere patch of sand or coral to fifty square miles in area. Only the larger ones are inhabited, the islets being used either as fishing stations or, if the soil is fertile, for native gardens.

The Islanders

Thirty years ago the fortune hunters of the world realized the worth of the Torres Straits pearls, and a rush set in to rake the bottom of the shallow sea. This brought many unscrupulous adventurers, who began to exploit the Torres Straits islanders, finally bringing them into slavery and almost to the point of extinction. The men were seized and kept almost constantly at work as divers; the women were scattered; separation from home and children ensued. Thus, with broken hearts and weakened bodies, a once high-spirited people succumbed to sickness, famine, and disease. About this time the evils of the industry came to the notice of the Queensland Government. The "Aborigines Protection Act" was passed to check any further ill-treatment of the natives. The "protectors," as the government inspectors were called, assisted by the missionaries of the London Missionary Society, began to encourage and enforce humanitarian ideas. As a result of these reforms, the natives are today a highly industrious, intelligent, and thriving people. Both men and women are tall, with regular, well-formed features that have attracted the attention of travelers and scientists. Their high state of moral and physical vigor is reflected in the fact that they are self-supporting. They not only support their families, their sick, and their aged, but also maintain without government aid their own institutions, such as municipal boats, churches, and schools. Sources of revenue are found in the main industries of the islands, in pearling, and the collecting of *bêche de mer*. The Government merely pays the teachers, the white administrators of the islands.

From the nature of their industries the islanders are born seamen, with an instinctive knowledge of the coral reefs and the movements of the uncertain winds for which the Straits are noted. No white man can take a lugger through the tidal rips and many other dangerous places around the islands with the ease and nonchalance of the native, who is remarkable for the skill with which he handles a swiftly speeding lugger, turning her within her own length in order to avoid some reef visible only to his keen eyes. The Straits are full of wrecks occasioned by foolhardy attempts of other navigators to sail the treacherous waters with their hidden coral reefs and complex tides and currents.

FIG. 1

FIG. 2

FIG. 1—A pearling station in the Torres Straits Islands
FIG. 2—The white administrator's home, Murray Island, Torres Straits

Characteristics of the Various Islands

Every island has features of particular interest in its history, its people, its scenic beauty, or its scientific importance. Mulgrave Island, more generally known as Badu, is famous for the prosperity of its people and their ready adoption of old English dances taught them by English missionaries many years back. The women make a most beautiful lace of fine quality. Mabuiag Island is distinguished by a remarkable native festival held every five years, to which natives flock from all parts of the group. This festival, once notorious as a gathering of warriors indulging in many savage rites often resulting in massacres, is now an interesting affair under the auspices of the Anglican Mission.

Yorke Island is noted for its history. It was off its palm-bordered shores that Spanish ships sailed hundreds of years ago. Many were wrecked in the coral-strewn waters, and to this day the sea is constantly giving up strange cannon, guns, swords, and old coins. The island was the home of "Yankee Ned," an American sailor who fled from his ship of war, amassed a great fortune in pearls, and married no less than eight native wives leaving numerous descendants.

Darnley Island has amazing native fish traps. These completely encircle the island and are in all sorts of figures, shapes, and sizes. They are made of gigantic boulders. It is difficult to see how they were brought into place. The natives have a tradition that the traps were made by great black giants who used the Islands of the Torres Straits as stepping-stones from Australia to Asia and were in the habit of picking up and throwing at each other in play these boulders, some at least 3 to 4 tons in weight. The natives account for the shapes of the traps by saying that the giants threw handfuls of boulders at one another and that they formed the squares, circles, and figures of eight.

Murray Island and its immediate waters are well known to scientists from all parts of the world. Owing to the various colors of the coral the effect of the sun shining on the sea is extraordinarily beautiful. Murray Island is also termed "The Garden Isle" for its beauty of hills, golden shores, native villages, and the profusion and variety of tropical plant life. Thursday Island, the capital of the group, is an important outpost of the British Empire inasmuch as its forts dominate the narrow straits through which steamers pass.

All of the island villages have strict health regulations. The result is freedom from epidemics. The native councilors, easily distinguishable by the word "Councilor" in white letters on the front of their red jerseys, are men of fairly high intelligence and strong personality. They are either elected by the people, or, in the case of a deadlock of votes, appointed by the administrator. It is part of their many duties to see that the villagers keep their houses, food, and clothing clean, that they send their children regularly to school, and that church is attended. They also visit the native gardens to see that they are properly tilled, and planted to their full capacity.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Relics of Arctic Expeditions Deposited with the British Admiralty and the Royal Geographical Society. The Crocker Land Expedition of 1913–1917 brought back to this country an exceedingly interesting collection of relics and souvenirs of earlier Arctic expeditions. As one of the three institutions that supported the Crocker Land Expedition the Society received the geographical portion of this collection. Thereupon the Council of the Society, recognizing the interest of the British people in those relics and objects which related to British expeditions, offered the larger part of the collection to the British Admiralty. Through the good offices of the British Ambassador at Washington and the British Consul-General at New York the collection was recently forwarded to London for appropriate distribution. Some of the more interesting items were described in "Notes on MacMillan's Ellesmere Island Trip" in the *Geographical Review*, March, 1918. A number of the articles that were connected rather directly with the past history of that institution were offered to the Royal Geographical Society at London for exhibition in their Museum. The objects retained by the British Admiralty are now in the Royal Naval College at Greenwich. Among those retained by the American Geographical Society are three records of the Peary Expedition of 1906 and a record of Dr. Kane's Expedition of 1903.

NORTH AMERICA

The Reform of Political Divisions on a Geographical Basis. Among the different political divisions in the United States none is more unscientific and ungeographical than the congressional district, particularly in the form given to it in the frequent re-adjustment of its bounds for partisan ends. In the American Political Science Review (Vol. 12, 1918, No. 3, pp. 403–426), C. O. Sauer discusses these political units under the title "Geography and the Gerrymander." He shows how utterly congressional districts depart from being true natural or geographic units, and attempts to indicate how they could be reconstituted with due regard for geographic factors. The states of Missouri, Kentucky, and Tennessee are cited, illustrating faulty, unscientific grouping of electoral districts. In these states, according to the author, distinctly marked geographical regions have been totally disregarded in the creation of their congressional divisions.

The geographic factors which the author would take into account in the determination of "natural areas" are location, topography, soil, drainage, and mineral resources. Climate, too, would merit consideration in districts, such as the extreme west of the United States, where sharply contrasted types appear within a limited area. A geographical unit would be "one in which conditions of life are in general similar, because of similarity of environment."

That this is the natural basis for regional division in a more or less primitive condition of society will be readily admitted. But that the same principle applies in an advanced culture, based upon interchange of commodities, is not so certain. Much of the Ozark country clearly forms a distinct independent district, where similarity of environment makes for community of interests. But this is not so true of other sections of the state where the economic relationships established by an interchange of unlike productions of dissimilar environment forms the strongest bond of union; where unity depends upon diversity rather than similarity of geographical conditions. This latter principle of classification, strongly advocated by the French geographers (led by Vidal de la Blache) in their discussion of the regional divisions of France, would seem to be as truly geographic and better suited as a basis upon which to reconstitute the recognizedly unscientific electoral units established by the gerrymander.

EUROPE

The Northern River Boundary of Yugo-Slavia. On this topic an interesting brochure has recently been published by Jovan Cvijic (Frontière septentrionale des Yougoslaves, Paris, 1919). Because it was prepared in support of the Yugo-Slav claims at the Peace Conference of Paris, the analysis cannot be accepted as a definitive scientific statement, though the first part of the paper contains important geographical data. The second part also includes a section of special geographical interest dealing as it does with the problem of rivers as boundaries. The area dealt with is the Pannonian Plain where the Drave and the Danube meet. Both streams have meandering courses which are shifting toward the right. The consequence is that the thalweg of each stream is progressively dis-

placed. Were it taken as an international boundary line, each change in the river would alter the frontier. The alternative is to fix upon a given location of the thalweg as definitive and monument it for all time.

For example, following the actual displacement of the Danube in past years the administrative frontier between the Bačka and the Baranya did not correspond with the course of the stream but with the channels of certain abandoned meanders. In the case of the Drave many minor changes of the same sort have occurred, but the principal one is the district of the so-called "Island of Repaš" (commune de Gola). Reference to the accompanying figure will show that the river once had a more northerly course which has been shifted to its present one, leaving the old course as an insignificant drainage line. The administrative boundary was fixed at a time when the river took the more northerly course; and it has been maintained in that position ever since. Farther down stream the old course of the river has also remained the administrative frontier in spite of the shifting of the stream to a more southerly position.

Such displacements of the thalweg involve endless disputes which would have to be settled by later agreements and surveys. For example, there is the case of the Drina, which, according to the Congress of Berlin (1878), became the frontier between Serbia and Austria-Hungary, thus giving rise to a dispute before a mixed commission. Almost as soon as the commission's findings were announced new displacements in the course of the river gave rise to new negotiations.

By the terms of the treaty of peace with Hungary the boundary between Hungary and Yugo-Slavia is established on the old and well-monumented administrative boundary that at one time followed the earlier course of the Drave. This puts a larger number of Yugo-Slavs in the Serb-Croat-Slovene Kingdom than would be the case if the present course of the Drave were followed. At the same time it leaves the advantages of river control equally in both hands, because each power controls both banks of the river at a number of points.

Spanish Meteorological Service and its Publications. In the field of meteorology, in its international aspects, there has been a serious dearth of available material from Spain. The lack has been felt particularly in attempts to correlate data regarding the movements of extra tropical cyclones, many of which cross the Iberian peninsula. Though observations had been made during many years, because of an unsatisfactory organization of the service the results had been inadequate and the data collected had appeared in different publications, partly in the *Anuario Estadistico de España* (1858–1864), partly in the *Resumenes de Observaciones Efectuadas en España*, issued by the Astronomical and Meteorological Observatory of Madrid (1865–1900).

In 1906 the entire meteorological service was entrusted to the Instituto Central de Meteorología, (since 1911 called the Observatorio Central Meteorológico) which forms one of the departments of the Instituto Geográfico y Estadístico. A marked improvement resulted. That office is now issuing in consecutive form the data collected during many years by the different organizations, official and cooperating. These appear in the *Resumen de las Observaciones Meteorológicas* of which volumes 5 to 12, covering the years 1901 to 1916, have recently been issued; and in the *Anuario del Observatorio Central Meteorológico* which, with its *Suplemento* contains also various studies of meteorological and climatic conditions in Spain. These studies cover such subjects as *Tormentas* (thunder-storms). Cyclones and Anticyclones, Rain Zones, Early Frosts, Aerology, etc. The usual maps are employed to show atmospheric pressure, temperature, rainfall and the paths of storms. In addition to reports of stations maintained on the peninsula, data from four points along the north coast of Africa and from the Canary Islands are included. On the island of Tenerife, where formerly existed the international aerological station, there is now established a similar Spanish observatory, which, besides the usual meteorological observations, records solar radiation and conducts investigations of upper air conditions. This observatory is situated 7,740 feet above sea-level near the base of Mount Teide. The results of the observations made there are published in the *Suplemento* to which reference has already been made (see *Anuario del Observatorio Central Meteorológico* Vol. I, (1916) and José Galbis y Rodríguez, Estado Actual de Nuestra Organización Meteorológica; *Ibérica*, Jan. 18. 1919, pp. 40–44.)

AFRICA

An Over-populated Island. In an extraordinarily limited environment the natives of Bukara (Ukara) Island in the southeastern corner of Lake Victoria Nyanza, have multiplied until today they number 19,000 on an area of only 36 square miles, and much of that is bare granite. There is "hardly a tree of respectable size to be seen anywhere." The climate is hot and stormy and marked by heavy rainfall which works havoc with the exposed fields. Faced by social and physical problems of the most trying kind, and isolated from the rest of the world, the natives have developed great ingenuity in solving the problem of survival

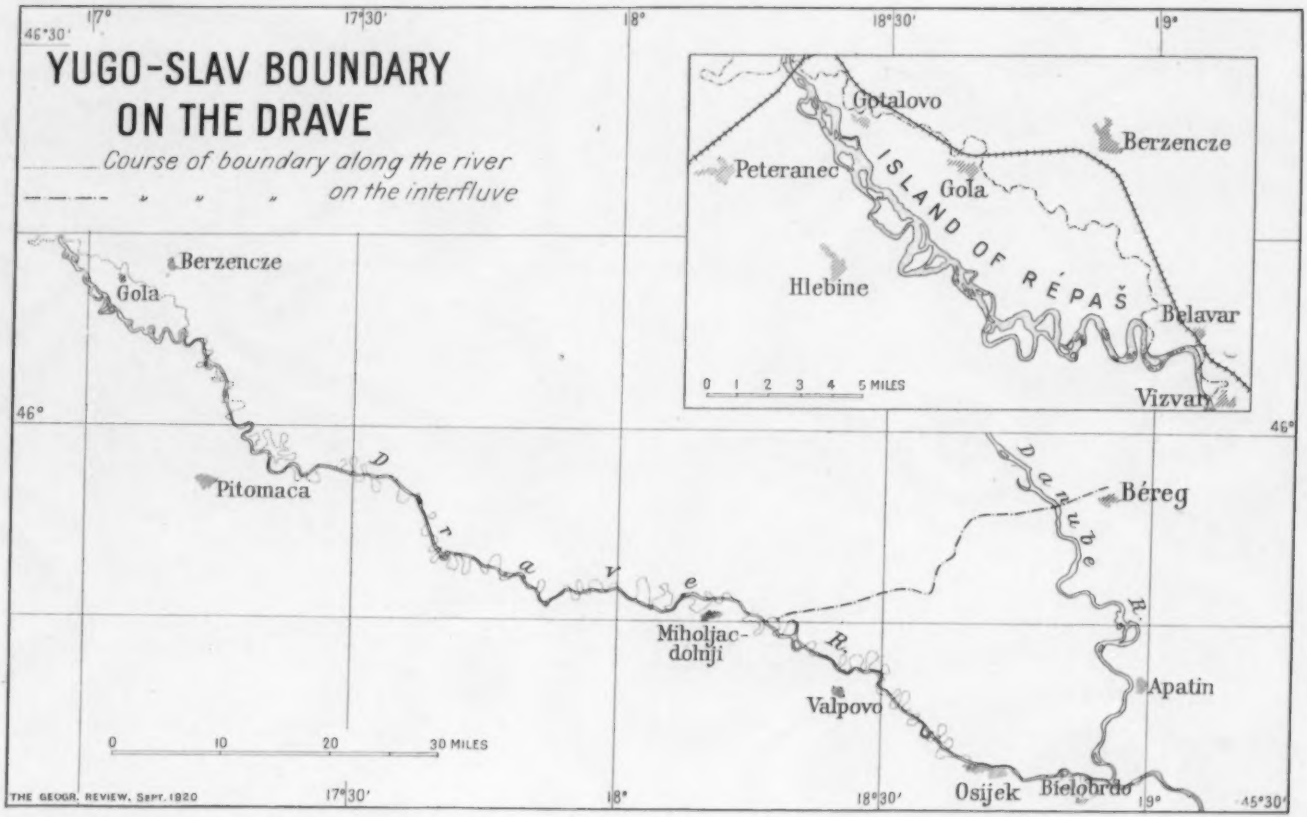

FIG. 1—North of the Drave is Hungary; south of it is the "Kingdom of the Serbs, Croats and Slovenes," or Yugo-Slavia. Where the common boundary of these two states lies close to the river it is represented by a dotted line in order to show detail more clearly. Between the Drave and the Danube the boundary is represented by a dot-and-dash line. The inset shows details of river and boundary at the Island of Repaš where the former course of the Drave, now an almost dry channel, is represented by a dot-and-dash line. The inset also shows the complicated relations of the new boundary and the railway at Gola. The scale of the main map is 1: 1,000,000.

in a state of over-population (H. L. Duke, Bukara Island, *The Cornhill Magazine*, June, 1920, pp. 705–710).

Economy has been carried to the point where every fertile area is used for village sites, gardens, or grazing-grounds. Each garden plot has an extent of 80 to 100 yards by 30 to 40 yards and is marked off by granite boundary stones, trees, or bushes. Rights of ownership are rigidly observed. As in the case of the native holdings of parts of the Anglo-Egyptian Sudan, the trees are valued more than the land on which they grow. One man may own the trees and another the ground: "a tree, if properly exploited, is a priceless possession." A man must not even steal his neighbor's leaves nor his sticks nor his rubbish! A father may even divide a tree among his children apportioning certain branches to each. There is the utmost economy in the use of the soil and the collection of fertilizer for it.

In addition to small individual holdings of grassplots for pasture there are communal holdings by villages. Mature grass is carefully husbanded for thatching, never burnt as among so many natives elsewhere. "It belongs to the chief, who doles it out to his subjects as required."

Artificial stone and earth embankments check the loss of the soil. A deposit of clay is worked for pipes and cooking pots but some clay has also to be imported from the mainland fifteen miles away. The steep-roofed huts are divided into two compartments, one for the native, the other for his cattle. Food is ground on flat rock surfaces, not in mortars. Twins and triplets are killed though the white man's coming will doubtless change this custom. It would seem that the limit of population capacity has been reached on Bukara and that emigration to the mainland must follow in the years to come.

A Recent Study of the Rift Valleys of Africa. Among the major relief features of the earth the African Rift Valleys are certainly one of the most interesting. Treated by one who has known them intimately for many years and who has recently extended his field observations they are seen to be as important in systematic physiography as they are attractive scenically (J. W. Gregory, The African Rift Valleys, *Geogr. Journ.*, Vol. 56, 1920, pp. 13–47).

After a spirited and clear description of their physical features and their extraordinary extent from Palestine to South Africa (illustrated with photographs and topographic sections) the author comes to the explanatory portion of his theme and here there is much to criticise. Almost nowhere does one obtain actual data respecting the evidence of the structural faults. There is always an obvious assumption that steep rock walls disposed in linear fashion, and often in opposition, on either side of a broad valley of flat or gently rolling relief, must mean faulting. No geologic sections are given, only the ground plan and topographic profiles. This is all the more surprising in view of the fact that much geologic evidence is supplied concerning the age of significant deposits and the character of the rock in an attempt to determine the sequences of topographic development.

The author's use of theory is startling and reaches its climax in the last paragraph where the difference in character of the American and African earth movements is explained by their antipodal relation. "Africa was antipodal to the Pacific, and it is in accordance with the well-known antipodal relation of ocean to continent that while the Pacific was sinking and the crust beneath it undergoing compression, its antipodal land should be rising and subject to tension." The uncritical nature of the statement is hidden from the layman by a beguiling assurance and plausibility of statement which is almost an integral part of the author's style. In the statement "Nor is there anything in America to correspond with the long tension rent of the Great Rift Valley" the author apparently overlooks the claims of the Rocky Mountain trenches of which the principal one extends in an almost straight line for 900 miles (R. A. Daly: The Nomenclature of the North American Cordillera between the 47th and 53d Parallels of Latitude, *Geogr. Journ.*, Vol. 27, 1906, pp. 586–606). While the rifts of the basin-range country of Nevada do not have the extent of the narrow and elongated rift valleys of Africa there is a correspondence of structure and process, and locally of relief, if the foundered structural arches and youthful fault scraps be considered.

AUSTRALIA

A Special Form of Sub-surface Drainage in Australia. There is a fairly wide distribution of certain features of minor drainage in Western Australia that appear to have considerable physiographic significance, according to a recent account published by M. Aurousseau (Proc. Linnean Soc., New South Wales, 1919, pp. 826–827). In the region in which it occurs—on the flanks of the Darling Range—the slopes are soil-covered, and the forms are developed in the piedmont deposits on the margin of the slopes. There occurs a series of small holes of different sizes up to a foot in diameter and three feet deep, spaced irregularly along definite lines. These holes also occur on the steeper soil-clad slopes. Their walls are steep. The sub-surface channels with which they are related have no relation to contour. It appears that the sub-surface drainage is formed in fissures in the sub-soil that

develop in the hot dry summer and into which the heavy winter rains sink. The water flows along the fissures which then become widened into definite underground channels, with slumping from above thus bringing about surface pits and depressions. It appears that apart from its physiographic effects the matter has importance in diverting a larger part of the rainfall to underground reservoirs than would otherwise be the case.

PHYSICAL GEOGRAPHY

The Evolution of Climate. Climatic studies in recent years have furnished a meeting ground for geographers and geologists perhaps more extensive than any that has been supplied outside of the technical study of land forms and their dates of origin. A recent contribution to the subject deserves special notice because of its critical quality and the nature of its conclusions (Evolution of Geologic Climates, by F. H. Knowlton, Bull. Geol. Soc. Amer., Vol. 30, 1919, pp. 499–565). It would require too much space to review in detail the successive arguments of the author. He has analyzed the subject principally from the standpoint of paleobotanical evidence. He then turns to the consideration of the atmosphere, sources of heat both within and without the earth, the effect of ocean temperatures, and the convergence of these factors, at least in part, upon the character of plant life. It is the latter part of the paper that lies more particularly in the geographical field, since it relates to the shifting of the position of the poles, changes in atmospheric and deep sea circulations, the effect of volcanic dust, etc.

The conclusion of the author is that the non-zonal climates of the past, and particularly the conditions of polar geniality of climate and tropical or subtropical glaciation, prove fatal to the hypothesis of solar control. He believes that the sun was not the dominant factor in maintaining temperatures on the earth during recorded geologic times. In his view it is the earth itself that has supplied the greater amount of heat that went into the disturbance or modification of the solar régime. He leaves untouched the question of the source of the heat, whether in the form of original earth heat or some augmented form of radioactivity, or a combination of these two.

Solar Variations and the Weather. Meteorologists are viewing with considerable interest the establishment of a new solar constant station in the Harqua Hala Mountains of Arizona and the removal of the Calama station, Chile, to a nearby mountain peak. The former will probably be in operation by October, 1920. Since 1912, when nearly simultaneous determinations of the solar constant of radiation at Bassour, Algeria, and at Mount Wilson, California (Smithsonian Astrophysical Observatory), seemed to show synchronous variations in the intensity of sunlight reaching the outer limits of the atmosphere, there has been until recently an unquestioning acceptance of Dr. C. G. Abbot's theory of short-period variations in the solar output of heat that reaches the earth. Determinations made day after day during several summers at Mount Wilson and, since July, 1918, throughout the year at Calama, Chile, have showed variations which in the course of a few days amount to 5 or even 10 per cent. Meteorologists began to look for earth effects, and Mr. H. H. Clayton showed that small variations in temperature and indirectly, therefore, in pressure occurred a few days following the variations in the determined values of the solar constant (see abstract in *Geogr., Rev.*, Vol. 5, 1918, p. 244). Encouraged by his results, Mr. Clayton subjected the solar constant data and subsequent weather in Argentina to a more rigid mathematical comparison, and published an interesting paper (*Smithsonian Misc. Colls.*, Vol. 71, No. 3, 1920), the most important point of which was that the temperature at Buenos Aires reached well defined maxima about 3½ days after high values of the solar constant as determined at Calama.

At this juncture, Professor C. F. Marvin made a thorough statistical analysis of the 1,500 determinations of the solar constant by the Smithsonian Astrophysical Observatory, and published a short note in the *Monthly Weather Review* summarizing his findings (Mar., 1920, Vol. 48, pp. 149–150). These determined values must include not only the variations of the sun, but also the small observational errors and those due to changes in atmospheric transmission during the course of the series of observations made for each determination of the solar constant with the bolometer (an instrument which measures the heat value of different parts of the solar spectrum). As instrumentation has become more accurate, the apparent variability of the solar constant has become less. Also, a recently introduced, short-cut, empirical method for getting the solar constant, from essentially one observation with a pyranometer, seems largely to have eliminated the errors due to changing atmospheric transmission, with the result that the variations in the solar constant as determined by it, are appreciably smaller than those obtained with the bolometer. Even if the instrumental and observational errors are set at a very small figure, it seems that solar variations must be very small.

But forecasters at Buenos Aires and, as I have been told, at Rio de Janeiro, are using the Calama data, received daily by telegraph, to forecast temperature. The 3½-day interval

between high values at Calama and high temperatures at Buenos Aires becomes a 5-day interval at Rio. It is possible, though it seems unlikely, that the variations in the solar constant as determined at Calama and in the temperatures farther east are due to atmospheric changes that reach Calama first. But how else than by the interception of sunlight by travelling clouds of electrons can the marked drop (about 7 per cent) in the solar constant observed at the time of the great aurora on March 22, 1920 (C. G. Abbot, *Monthly Weather Review*, April, 1920, Vol 48, pp. 227–228, Washington, April 28, 1920) be explained?

If the sun does vary appreciably, the simultaneous determinations of the solar constant in Arizona and in Chile will show synchronous changes. If it does not, the establishment of additional solar constant stations may prove necessary to discover what variations there are. The Weather Bureau is now embarking on a thorough investigation of what synchronisms or sequences there may be between the solar constant as determined, and various weather elements, especially temperature (*Bull. Amer. Meteorol. Soc.*, June, 1920, Vol. 1, p. 62).

CHARLES F. BROOKS

GEOGRAPHICAL NEWS

Change in Scope and Title of *The Plant World*. The publishers of *The Plant World* announce a change of title to *Ecology*, beginning with the January number, 1920, which becomes Volume I, Number 1, of the new publication. A foreword by Barrington Moore, President of the Ecological Society of America, outlines the scope of ecology. There is a reference to geography as human ecology and the first number contains a paper by Ellsworth Huntington, entitled "The Control of Pneumonia and Influenza by the Weather." There is also a continuation of A. E. Douglass's studies on the growth rings of trees in a paper entitled, "Evidence of Climatic Effects in the Annual Rings of Trees." The principal conclusions of this paper show a very marked advance in the complicated studies of the meaning of rings of growth in terms of climatic factors (see also the review of "Climatic Cycles and Tree-growth on p. 195 of this *Review*). On account of their importance and the possibilities of extending Douglass's methods in widely separate areas of the world, the conclusions are here quoted in full.

"1. Trees probably integrate, and may be made to disclose to us, climatic combinations advantageous to certain types of vegetation.

2. The study of this subject promises to enable us to outline what might be called agro-meteorological districts, that is areas over which exist similar advantageous combinations of weather elements.

3. The application of the criterion of mean sensitivity promises to make possible the proper selection of sequoia records, which in turn will give much climatic information about the last 3,200 years.

4. Information regarding suitable forests for similar study, located in central and other parts of North America, will be greatly appreciated by the writer."

GEOGRAPHICAL REVIEWS

Territorial Problems of the Peace Conference

C. H. Haskins and R. H. Lord. **Some Problems of the Peace Conference.** xii and 307 pp.; maps, bibliogr., index. Harvard University Press, Cambridge, 1920. 9 x 6 inches.

Publications on the Peace Conference of Paris, 1919, are of special interest to geographers because the questions of territorial boundaries and their relation to the distribution of people are necessarily discussed in practically every one of them. The map of Europe has been redrawn. The basis of the new lines, the conditions of the new settlement, the derangement or improvement of the economic life, all involve in their discussion the physical data of geography, the intricate, intimate details of relief and hydrography, of soil and climate and forests, and scores of distributional factors that relate to the earth as the home of man. In their effects on man the new conditions of life must be thoroughly analyzed from the geographic standpoint; and this it is difficult to do until new census statistics are available and old statistics officially revised. If these things be so it is well that geographers should also know a great deal of the background of the settlement, if only that they may be more discriminating in the selection and use of the available data. That background is altogether difficult to acquire. To understand this let us look at some general considerations.

So diverse were the objects of different nations and peoples during the war that no set of formulae could have been found to fit Allied purposes. When, with new hopes suddenly inflated by a sweeping victory, the Allies gathered for the settlement, they were confronted by an impossibly difficult task. No treaty could have been drawn that would have satisfied more than a small fraction of humanity. Necessarily confined to a generalized program, the preliminaries of the armistice and the Peace Conference received almost universal approval only because they were put into general terms. The moment that specific settlements had to be proposed every interested party felt betrayed. And the peoples of the whole world were all talking at once. A delegation from Orawa in the foothill region of the Carpathians came to Paris in native peasant costume to argue union with Poland; Slovene representatives came to argue against Italian ownership of Fiume; Macedonians came looking for the millenium. Opposed to these were equally earnest advocates using the same formulae, the same glittering phrases interspersed with "liberty," "justice," "humanity," "self-determination." Many of the rival arguments of Rumanians and Serbs for possession of the Banat were almost precisely the same; only the statistics were different! In the presence of admittedly doctored official statistics there was only one course to pursue—fight fire with fire. Each one of the Central European nationalities had its own bagful of statistical and cartographical tricks. When statistics failed use was made of maps in color. It would take a huge monograph to contain an analysis of all the types of map forgeries that the war and the Peace Conference called forth. A new instrument was discovered—the map language. A map was as good as a brilliant poster, and just being a map made it respectable, authentic.

The confusion of political purposes, the vast scale of the complicated negotiations, and the high stakes of the conference, tempted every journalist to dramatize his account. Never before has journalism broken down so completely in the face of a great task—a breakdown which was not altogether the fault of journalism. In consequence there is not even an approximately reliable well-rounded account of the Peace Conference in print. Its work has been written up from the political and the journalistic standpoints, not as history. Even the geographic work of the conference has been analyzed in a partisan spirit.

In the midst of this Stygian darkness it is heartening to see a light upon the way. Haskins and Lord have done the world a service. Geographers as well as historians are their debtors. These two scholars, bred in the spirit of research, think and write as men seeking to reveal truth. The first chapter is entitled "Tasks and Methods." Its literary style and subject matter make it most interesting to the general reader. Its thirty pages are worth more than five hundred of any other book on the peace conference. The conservationists could find here a new text. A serious part of the material wastage in this world is due to our lax system of allowing poor writers to spoil good paper. A tree, even of the pulpwood variety, is surely a nobler thing than an untruthful and misleading even though chatty and apparently intimate volume.

It is the statistical matter, dealing with economic and ethnographic problems, that will be of greatest use to geographers. The authors have had the advantage of association

with a large number of experts on the "Inquiry," the organization that prepared research material for the American Commission to Negotiate Peace, and they have had the further advantage of knowing men and events on the ground. They served on various territorial commissions of the Peace Conference and speak with authority and not as the scribes. Their statements of fact were tested by the fire of actual experience. The refinement of statistical expression was a constant and necessary process in all the boundary settlements.

There is, however, no pretense to make the book a geographical treatise. The avowed object is a discussion of a single theme—the territorial settlements. The specific value of the book, from the standpoint of scholarship alone, lies in its vivid and authoritative treatment of the historical setting of each problem. The people of central and western Europe are accustomed to thinking historically. Some of the strongest motives of today have their sources from deep within what might be called the historical structure as well as the relations of a people. The motivations of the western democracies are of a wholly different type. The geographer who would really understand a people or a new nation now appearing on the map cannot have a balanced or scientific understanding of his problem if he deals only with the physical setting. So much has been written on the new boundaries established by the peace treaties by way of destructive criticism that a cool and scholarly analysis is most timely and useful.

The captious critic would find most of this book thorny reading. If the new boundary in the Banat of Temesvar cuts across a score or more of drainage lines and roads, if the new boundary of Hungary requires half a hundred custom houses, turntables and stations, it is indeed a calamity. But what is the other horn of the dilemma? It is easy to picture economic injustice when new boundaries have to be laid down. Has anyone drawn better proposals on a map? The world could not have survived the blow to it had the old boundaries been followed. The present chaos is deplorable; the chaos resulting from a denial of the national aspirations of Czechs, Serbs, and Poles would have been fatal. If these states had to be established they had also to be given vitality. It will be one of the most interesting and valuable of the future tasks of the geographer and the economist to see what adaptations of frontiers, or of physical or political circumstances will be evolved as a result of the fragmentation of Central Europe and the inevitable resulting disturbances to the economy of the inhabitants. We had thought of Europe as an adjusted region where life had become well fitted to environment; we see it now, in an instant, set to pioneering again—not in the old sense, but in a political and social sense, with only the old geographical and historical foundations on which to build.

The book covers but a part of the European settlements and does not touch the other continents. For example, the Baltic states are not treated, nor is there a statement of the Turkish or Pacific or Far Eastern problems. This is due to the limitations of the lecture form in which the several chapters were prepared and the brevity of the course (Lowell Lectures). The maps leave much to be desired. An invaluable feature is the well-selected list of references partly to original and partly to secondary sources of material.

The Irrigation Problem in the Nile Basin

William Willcocks. **The Nile Projects.** xii and 184 pp.; maps, diagrs., index. [Cairo], 1919. 10 x 6½ inches.

Murdock MacDonald. **Nile Control Works.** 16 pp.; map. Ministry of Public Works, Cairo, 1919.

One of the claims of Egyptian nationalists is that Egypt is taxed for the benefit of the Anglo-Egyptian Sudan and that in the material development of the Sudan insufficient account is taken of the water problems of the lower Nile valley. These political differences between the Egyptian leaders and the British administration find a basis in a difference of opinion on the part of the engineers upon the best method of regulating the irrigation waters of the Nile. The two papers here dealt with present opposite views. Despite their controversial character the papers are of great value to the geographical student in their presentation of a clear picture of the present irrigation situation in Egypt.

The battle of Omdurman marks the beginning of the recent period in which British engineers have sought to extend the cotton lands of the Nile valley by a more conservative use of Nile waters. The two great enemies of the country are drought and inundation. Sir William divides the Egyptian year into three seasons: summer, flood, and winter. The first extends from the beginning of April to the end of July, when the Nile is at its lowest. The second extends from the beginning of August to the end of November, when the Nile overflows its banks. The third includes the months of December, January, February, and March, when the Nile is confined within its channel but carries a supply in excess of agricultural requirements.

Associated with each of these three seasons there are three groups of crops. The summer crops are cotton, sugar cane, millets, rice, vegetables, and fruit. The flood crop is maize

or millets and flood rice over restricted areas. The winter crops are wheat, beans, barley, vegetables, peas, and clover. Parts of Egypt have perennial irrigation, and these can produce two or three crops a year. Others are irrigated only in flood, or if they are below the level of the Nile flood they may carry water for some time, which water is then drained off and the ground tilled. There is an elaborate statement of the problems of cultivated and uncultivated land in the several regions of Egypt and the proportion of cultivated land that receives its water supply by each of the two systems mentioned above.

Sir William emphasizes the fact that aside from flood protection the great problem of Egypt is to secure a water supply sufficient to furnish irrigation water when the Nile is low. Otherwise there is insufficient room for the very rapidly growing population, which has doubled in the last forty years and is increasing at the rate of 200,000 a year. He emphasizes particularly the value of the Sudan region of the White Nile, hitherto unutilizable, a vast waste of marsh and water which receives the flood waters of the Lake Albert region and which if properly controlled by engineering works could be made to supply all the water needed for many years to come. He would utilize the fall of the Nile to generate electrical power for lifting water otherwise unavailable. Associated with this plan is that of changing the present wasteful "basin irrigation system" of upper Egypt, which involves the flooding of low-lying bodies in the Nile Valley, to "perennial irrigation" which requires the conservation of flood waters and the pumping of the river water into the irrigation canals. The peak of the annual flood would thus be taken off and Egypt freed from all danger of inundation.

A Montana County Geography

O. W. Freeman. **Geography and Geology of Fergus County.** 71 pp.; map, ills., bibliogr., index. *Fergus County High School Bull. 2*, Lewistown, Mont., 1919.

This small handbook, descriptive of a county in the center of Montana, has been prepared less for school use than in response to a demand for instruction on the part of the public. It is an excellent example of the manner in which an enterprising school may itself reach out to edify the adults of the community, and it therefore deserves grateful recognition.

The first bulletin of this series, published over ten years ago, described the "Birds of Fergus County"; a third is planned on the "History and Civics" of the county, for which we trust it may not be necessary to wait another decade, and in which we earnestly hope to see expression of a vigorous and whole-souled but not boastful American spirit, clearly stating our ideals and fairly setting forth our successes but not glossing over difficulties, dangers, and failures.

The chapters of the present bulletin give a good selection of information on the physical features and setting of the county, its towns and cities, geology and mineral resources, climate and ground water, soils and the relation of these features to agriculture and settlement.

The final chapter deals with the origin of local names. The text is embellished by several half-tone illustrations, one of which is an exceptionally fine two-page view showing foothills, bench land and bottom land, the locality of which is unfortunately omitted. The outline map of the county, supplied from the state capital, would be much improved if redrawn on a larger scale and reduced so that the lines and the lettering should be finer and clearer; the name of Musselshell River should be added along the eastern border. The bibliography at the beginning and the index at the end of the bulletin add much to its value.

Fergus County fully deserves not only three but a whole series of bulletins, for its area is almost as great as that of Massachusetts. It occupies the southwestern angle between the Missouri and Musselshell Rivers, and includes on its southwestern border parts of the Little Belt and Big Snowy Mountains of anticlinal structure, marginal members of the Rocky Mountain system. Near the county center the Judith and Moccasin mountains are residual masses maintained on igneous sheets and dikes in the higher members of the horizontal Plains strata; but the greatest part of the county lies in the Great Plains province. It offers an excellent field for geographical and geological exposition. As a general comment on the method of presentation employed, in so far as geography is concerned, it may be noted that the connection existing between various related facts is, by reason of their separate mention in different chapters, too often less explicitly brought out than is desirable as a means of introducing the "causal notion" into the popular conception of geography. For example, the second chapter on towns and cities is almost wholly empirical in its descriptions; again, the paragraphs on caves, which are described under "picturesque features" with a disproportionate amount of space given to ice caverns, do not sufficiently emphasize the control of their distribution by the tilted outcrops of the heavy mountain limestones. The penultimate chapter on geographical influences and consequences stands too far removed from the earlier accounts of physical features. The chapter on climate would be much improved if vivid explanatory descriptions of different types of weather were added to the text and tables in which the average values of climatic elements are presented.

On the other hand, by searching through the various chapters more information will be found concerning the origin of surface forms than is usually to be discovered in popular scientific essays. Properly enough, in view of the object of the bulletin, greater space is alloted to the nonapparent facts of geology, such as the great series of stratified formations from Cambrian to Tertiary, than to the manifest facts of geography, in spite of the first place given to this subject in the bulletin title; but geographers must be grateful for the intelligence with which many topics of their science are handled.

The reviewer heartily joins the author in wishing "to commend the long-sighted vision and the broadmindedness of the Board of Trustees in their efforts to disseminate local information." May their good example be widely followed!

W. M. DAVIS

AN ENGLISH COUNTY GEOGRAPHY

W. W. WATTS. **Shropshire: The Geography of the County.** x and 254 pp.; maps diagrs., ills. Wilding & Son, Ltd., Shrewsbury, England, 1916. 2s 6d. 7 x 5 inches.

Had this attractive little volume been given the subtitle of "A General Description of the County" and published as one of a series of "County Handbooks," instead of as one of a series of "County Geographies," those interested in the progress of geographical science would not need to concern themselves particularly with its contents or its method of treatment; for all sorts of topics would have been properly included under a general title. But when all sorts of topics are gathered under the title "Geography" and presented in a manner that too frequently omits the essential characteristics of good geographical treatment by failing to point out the connection between event and environment, geographers must express their regret at the misunderstanding of their subject that will result, all the more because the author of the book is a scientist of high standing, whose opinion as to what constitutes geography will be accepted as authoritative by most readers.

The method of the book may be illustrated by two of its chapters. The first includes a section on physical features, under which the relief of the shire is described for the most part empirically, following a method that is going out of fashion even for popular handbooks. The following section treats the geological history of the underlying formations rationally, although with attention chiefly directed to depositional history and with insufficient consideration of erosional history, which in a geographical handbook is surely of equal importance.

The longest chapter of the book attempts to deal with "Historical Geography" and indeed presents much information on races and population, place names, written history, prehistory and antiquities, buildings and architecture, and great Salopians. All of this chapter is replete with interesting details, but it might have been just as well or better called county history, for it follows the order of time, not of place; and it too frequently omits all indication of a causal connection between occurrences and places, by which alone a truly geographical flavor can be given.

The really significant feature of this little book as a "County Geography" is that it represents the prevalent British idea of what a county geography ought to be; that is, a vaguely defined mixture of geology and history. Now that a "geographical tripos" and "honors in geography" have been established in at least one of the leading Universities of England, we shall look to the professors of geography there and to their students to redeem their subject from the status of a sort of hybrid learning and to develop it for itself just as geology and history are so worthily developed.

W. M. DAVIS

THE BRITISH FISHING INDUSTRY

NEAL GREEN. **Fisheries of the North Sea.** 178 pp.; map, ills. Methuen & Co., Ltd., London, 1918. 7½ x 5 inches.

A small, informing, and authoritative book on these fisheries, with final chapters on fishing ports and the migration of fish, and a brief notice of the industry in North American waters. The author wastes no words and covers much ground in small space. Among other things he points out that Britain does not import fish from any country under foreign flags for the reason that she is in the center of the greatest fishing grounds in the world; and these banks often provide ten times as much food per acre as does the same area of good land. The world, he says, has 10,000,000 square miles of shallow waters where fish thrive; and should now make the most of the food, oils, and other products that fish supply. Of all the British food industries, the fisheries have received the least permanent damage by the war. The quantity of fish landed during the war was only about thirty per cent of normal, but the annual landings may now be vastly enlarged. The concluding pages are given to the chief British fishing grounds near home and the consideration of what should be done for their further development.

CYRUS C. ADAMS

Tree Growth and Climate

A. E. Douglass. **Climatic Cycles and Tree-Growth: A Study of the Annual Rings of Trees in Relation to Climate and Solar Activity.** 127 pp.; diagrs., ills., bibliogr. *Carnegie Instn. Publ. No. 289.* Washington, D. C., 1919. 10 x 7 inches.

In 1901 Professor Douglass began a study of tree growth which bids fair to be one of the most fruitful sources of information as to climate. His method, which is already widely known, consists of measuring the width of the annual rings of growth and thereby determining the climatic conditions. Beginning with the pine trees near Flagstaff Observatory in Arizona, where he was then at work, he has carried his observations to the Pacific and to the Atlantic coasts, and to many countries of Europe.

In the present volume Professor Douglass sums up all his work to date (compare the abstract on p. 190 of this *Review*). He rightly devotes much space to a careful description of the methods which he has gradually evolved. How delicate those methods are may be judged from his ability to identify rings of growth. Even if he knows nothing as to the date of a piece of wood he can assign each ring to its proper year, provided he knows where the tree grew and has other trees of known age and the same species with which to compare it. He does this by a minute study of the relative thickness and general characteristics of adjacent groups of rings. It seems almost incredible that such high accuracy is possible, but there can be no doubt that the method is successful. In this way he has checked up the reviewer's long series of measurements of the sequoias in California and has found that in spite of minor errors the general curve of climatic pulsations derived from a study of the big trees is correct.

Other parts of Professor Douglass' book are devoted to the correlation of the tree curves with the rainfall and with sun spots, and to a study of cycles. In addition, an important section describes methods of "periodic analysis." By the means of a periodograph of his own invention the author is able to analyze any sort of curve and find what periodicities it shows. This is done by photographing the plotted curve through a fine grating. If there is no periodicity the photograph assumes a hazy or dotted appearance. If there are periodicities, a series of parallel lines appears.

The chief results of Professor Douglass' work may be summed up as follows:

(1) He has developed a unique method and a highly perfect technique for the study of tree growth.

(2) He has shown conclusively that there is a close relation between the thickness of the rings of growth and the climate. This relation varies greatly from region to region, but the relationship can readily be worked out if sufficient data are at hand.

(3) He has shown that the tree records covering centuries agree with meteorological records covering decades in showing that the rainfall of different regions varies in opposite directions. This may happen even when places are only a few hundred miles apart, as on the eastern and western sides of the Scandinavian Peninsula.

(4) Professor Douglass has also shown that many of the curves of tree growth show a distinct correlation with changes in the number of sun spots. This is particularly marked in central and northwestern Europe.

(5) He finds a great number of cycles which he tabulates as follows:

5 to	6	years,	approximate	half	sunspot	period
10 "	13	"	"	full	"	"
21 "	24	"	"	double	"	"
32 "	35	"	"	triple	"	"
100 "	105	"	"	triple-triple	"	"

The chief criticism of Professor Douglass' work is that he perhaps overestimates the regularity of cycles. There can be no question as to the existence of cycles and as to their importance. To the reviewer, however, the cycles seem to be so irregular that it may be doubtful whether we are justified in assigning any exact periodicity.

Ellsworth Huntington

The Official Year Book of Australia

G. H. Knibbs. **Official Year Book of the Commonwealth of Australia, Containing Authoritative Statistics for the Period 1901-1918 and Corrected Statistics for the Period 1788 to 1900. No. 12, 1919.** xxxviii and 1234 pp.; maps, diagrs., index. Commonwealth Bureau of Census and Statistics, Melbourne, 1919. 9½ x 6½ inches.

The practice of the Commonwealth governments of Australia and New Zealand of publishing official yearbooks in which the current results of a number of government bureaus are recorded gives these publications a special value to the investigator. In the case of Australia the Bureau of Census and Statistics is the coördinating agency. In its latest pub-

lication, that for 1919, statistics for the period 1788–1900 are revised and those since 1900 are brought down, in authoritative form, to include 1918. Thus there is a complete statement of Australia's activities in the war and a statistical summary, graphically illustrated, of the relative cost of food, groceries, and house rent in relation to distribution of population for the years 1913 to 1918 inclusive. The latest irrigation developments are treated in detail. In fact, practically every aspect of Australian life in which a geographer might be interested is described or analyzed or illustrated by statistics or graphs. It may be noted in passing that the American Geographical Society has for several years given considerable attention to completing its collection of yearbooks owing to the growing value of many of them in scientific research.

The Australian yearbook for 1919 contains an orographical map of the Commonwealth that deserves special mention. Since 1903 the Weather Bureau has been collecting appropriate data for the map, and these have now been assembled and supplemented, and the contours redrawn, by Dr. Griffith Taylor, Commonwealth Physiographer and now also Professor of Geography at Sydney University. For much of the area the contours are only form lines sketched between stations of known height. For the rest the contours represent surveys of moderate detail. The result is that we have a general assembly of most diverse data but the whole so critically treated according to accepted cartographical principles as to make a real contribution to knowledge.

The map is in eight altitude tints separated by 0, 500, 1,000, 2,000, 3,000, 4,000, and 5,000 feet; and there is a separate shading for the land below sea level principally on the eastern and southern margins of the Lake Eyre depression, the surface of the lake being 39 feet below sea level.

This number of the yearbook also includes a specially contributed article, "The Plains and Peneplains of Australia," by E. C. Andrews.

A Centennial of American Science

E. S. Dana and Others. Edits. **A Century of Science in America, with Special Reference to the American Journal of Science, 1818–1918.** (Mrs. Hepsa Ely Silliman Memorial Lectures, Vol. 14.) 458 pp.; diagrs., ills., bibliogrs. Yale Univ-Press, New Haven, 1918. $4. 9 x 6 inches.

Among the thirteen chapters in this book, Chapter 3, written by Professor H. E. Gregory, of Yale University, is of interest to geographical students as a brief history of progress in the interpretation of land forms. In addition to many valuable sidelights on the history of the development of physiographical thought the chapter contains a useful bibliography of seventy-three titles, covering nearly all phases of the science.